PREFACE

INTRODUCTION

By R. C. L. PERKINS.

FAUNA HAWAIIENSIS

OR THE

ZOOLOGY OF THE SANDWICH (HAWAIIAN) ISLES:

Being Results of the Explorations instituted by the Joint Committee appointed by

THE ROYAL SOCIETY OF LONDON FOR PROMOTING NATURAL KNOWLEDGE

AND THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

And carried on with the assistance of those Bodies and of the Trustees of

THE BERNICE PAUAHI BISHOP MUSEUM AT HONOLULU.

EDITED BY

DAVID SHARP, M.B., M.A., F.R.S.

SECRETARY OF THE COMMITTEE.

VOLUME I. PART VI.

PREFACE

By the EDITOR.

INTRODUCTORY ESSAY ON THE FAUNA

By R. C. L. PERKINS.

Pages i—ccxxviii *and* 16 *Plates.*

CAMBRIDGE

AT THE UNIVERSITY PRESS

1913

January 15*th*, 1913.

CAMBRIDGE UNIVERSITY PRESS
London: FETTER LANE, E.C.
C. F. CLAY, MANAGER

Edinburgh: 100, PRINCES STREET
London: WILLIAM WESLEY AND SON, 28, ESSEX STREET, STRAND
Berlin: A. ASHER AND CO.
Leipzig: F. A. BROCKHAUS
New York: G. P. PUTNAM'S SONS
Bombay and Calcutta: MACMILLAN AND CO., LTD

CONTENTS OF THE THREE VOLUMES, SYSTEMATICALLY ARRANGED.

As the memoirs have necessarily been published in an irregular manner, the following table will be found useful.

CONTENTS OF THE THREE VOLUMES ARRANGED ACCORDING TO THE AUTHORS' NAMES.

PREFACE

THE importance of the fauna of the Hawaiian islands has long been recognised, but as no adequate exploration of their zoology had been attempted, the British Association for the advancement of science appointed a Committee in the year 1890 "to report on the present state of our knowledge of the Sandwich Islands, and to take steps to investigate ascertained deficiencies in the fauna, with power to co-operate with the Committee appointed for the purpose by the Royal Society, and to avail themselves of such assistance as may be offered by the Hawaiian Government or the Trustees of the Museum at Honolulu." The Committee of the Royal Society just alluded to was appointed almost simultaneously, and the two Committees have continued to work together till the present time.

The joint Committee has received the most valuable support and assistance from the Trustees of the Bernice P. Bishop Museum at Honolulu. Indeed one of the most important duties in writing this Preface is to make this acknowledgment, and to return thanks for this support.

At an early meeting of the Committee it was decided to limit its investigation to the Land-fauna. Two reasons influenced this decision, viz. (1) that this was as much as the Committee could hope to accomplish, and (2) that while the Land-fauna was known to be undergoing great impoverishment, it was believed that the Marine-fauna was comparatively exempt from analogous changes.

The Committee decided to undertake an exploration of the Islands, and was so fortunate as to secure for the purpose the services of Mr R. C. L. Perkins, then a young graduate of the University of Oxford. Dr Perkins continued his exploration for some years. As he has given an account thereof in the Introduction that follows this prefatory notice it is unnecessary to give particulars here, beyond saying that he underwent great dangers and fatigues, in his arduous and solitary task, with the most determined perseverance, the most unflinching courage; camping out in the mountains, without a companion, for periods as long as he was able to carry food and equipment.

As the result of his work the Committee found itself in possession of an enormous number of specimens, and in pursuance of its work decided on investigating this material and reporting thereon.

It is not possible to state exactly the number of specimens that have resulted from Dr Perkins' labours, but it cannot be far short of 100,000, and not improbably exceeds that number. The Insects of the Archipelago were previous to this investigation supposed to be scanty in the number of species, and it was believed that individuals of each species were as a rule also very few. Both these conclusions have now been shown to be incorrect. Dr Perkins estimates the number of known species of this Class of animals to be upwards of 3,300; and he considers this number to be probably not much more than one half of the total Hawaiian Insect-fauna.

The other Classes of Arthropoda are represented by a considerable number of species. Mollusca is specially rich, nearly 500 species or forms having been recorded. Aves has about 50 peculiar species. The other Classes of animals have been by no means satisfactorily investigated, so that no general zoological Census of the islands can yet be given. But it may be said that at the present time if an exhaustive list of the land and marine fauna could be compiled it might amount to 10,000 species, the great majority of them being peculiar to these precincts. And even this number is liable to be greatly increased if the classes of microscopic animals were included; the Protozoa being, so far as is known to the writer, still untouched. These points are mentioned because it would be a matter for profound regret were it supposed that the work of this Committee—long as it may have lasted—has completed our knowledge of Hawaiian zoology. The Islands having now passed into the control of a State superabundant in wealth and power we may hope that some real effort may be made, by means of local Associations or expeditions from the United States, to supplement our imperfect knowledge. At present there is so far as we know, only one Natural History Association in the Archipelago—the Hawaiian Entomological Society, established in 1905.

Though the task of the Committee may be considered as still incomplete, various reasons render its dissolution advisable. The Committee has lost during its existence two Chairmen, and Dr Perkins who has done most of its work is not able to continue to make for it the great exertions he did make for so many years.

He has however drawn up for us a review of the subject of Hawaiian Zoology. This, in the form of an introduction, will follow this prefatory note. The fauna of the Archipelago has undergone great changes owing to human interference with the natural conditions. It has always been a difficult task to estimate what part of the Fauna is due to recent natural immigration, what to human introduction. The intimate acquaintance of Dr Perkins with the fauna for so many years gives a special value to his review, which, we have no doubt, will be of great assistance to future investigators.

It will be seen from his Introduction that he considers the whole of the fauna is due to ancient and recent immigration, and is now augmented by human introductions. And the peculiarities of the fauna apparently fully justify this conclusion. On this subject we may refer to Wallace's chapter on dispersal and migration (Geographical distribution of animals, Chap. ii) which correctly foreshadows the way in which this fauna has been formed. The peculiar conditions of life in Hawaiia are to some extent illustrated by the maps and landscapes that accompany Dr Perkins' Essay.

The Committees when first constituted consisted of Dr W. T. Blanford, Colonel Godwin-Austen, Mr O. Salvin, Dr P. L. Sclater, Mr E. A. Smith, with Sir W. H. Flower and Professor Alfred Newton as Chairmen, Dr S. J. Hickson as Treasurer and D. Sharp as Secretary. Subsequently Dr F. D. Godman and C. V. Riley joined it. Sir W. H. Flower and Professor Newton, the early Chairmen having deceased, their duties were taken up by the present Chairman Dr F. D. Godman. Professor Hickson the Treasurer, and D. Sharp the Secretary, have filled these offices throughout the 22 years of the existence of the Committee.

The Honourable C. R. Bishop, the founder of the Bernice P. Bishop Museum, has afforded by the instrumentality of the Trustees of that institution the most valuable assistance to the Committee; and as an acknowledgment thereof the Fauna Hawaiiensis has been dedicated to him.

It appears from the Accounts of the Treasurer that the Committee has derived its funds from seven sources, viz.:—(1) the Trustees of the Bernice P. Bishop Museum; (2) the Council of the Royal Society; (3) the Government Grant Committee of the Royal Society; (4) the British Association for the advancement of science; (5) the British Museum (Natural History); (6) Sale of the Fauna Hawaiiensis; (7) Bank Interest. The Treasurer reports that the total from these various sources amounts at present to £4717. 6*s*. 3*d*.

The first set of the specimens resulting from the work of the Committee has been placed in the British Museum (Natural History), which Institution possesses the types of all the new species described in Fauna Hawaiiensis (except possibly a very few described though the property of others). The second set of specimens has, as a rule, been given to the Naturalists who worked out the collections, and whose names will be found in the Table of Contents in Vol. I of the Fauna Hawaiiensis. The third set has been sent to the Bernice P. Bishop Museum, Honolulu. A considerable number of specimens has been given to Dr Perkins for his assistance in Honolulu, where he has been for some years a resident. In addition to these extensive parts of the collections, others have been given to the great Museums at Edinburgh, Dublin, Manchester, Cambridge, Christiania, Stockholm, Copenhagen, Paris, Berlin, Dresden, the Netherlands, Florence, Turin, and Boston U.S. The few specimens still remaining are promised to the Museum of Harvard University.

D. SHARP
(Hon. Secretary of the Committee and
Editor of the Fauna Hawaiiensis).

ERRATA

The following corrections should be made in the text:

Vol. I, p. 31, line 3, for 'first' read second.
Vol. II, p. 13, line 16, for 'interno' read externo.
,, p. 607, at bottom of page *delete N. conifer*, which is an *Odynerus*.
,, Pl. V, figs. 7 and 7 *a*, in description of Plate, for '*A. koelense*' read *A. amaurodytum*.
Vol. III, p. 591, second line from bottom, for 'Anobiids' read *Xyletobius*.
,, p. 616, line 7, twice, and lines 11, 12, 16 and 18, for 'I' read II.
Introduction, p. lxiii, 6 lines from bottom, for 'isolation' read specific endemicity.

INTRODUCTION

BEING A REVIEW OF THE LAND-FAUNA OF HAWAIIA

By R. C. L. PERKINS

This portion of the 'Fauna Hawaiiensis' may be termed an Introduction to the study of the land-fauna of the Hawaiian islands, and its chief use may be as a guide to further and more special research. It is rather in the form of a series of disconnected essays than a continuous account, this being due to the fact that it has been mostly written at wide intervals of time and in small portions, when the pressure of other work, which could not be neglected, was relaxed. Some repetition will consequently be found, and it has been necessary finally to cut short some questions, which it was intended should be fully discussed, and also to pass by many altogether. The rather full résumé of the Fauna that is given will enable any one to find further illustrations of many of the points that are discussed and furnish hints for further investigation. During the twenty years that I have been working on this Fauna I have received much help in various ways from many people, all of whom I cannot mention individually. To Dr D. Sharp and the late Prof. Alfred Newton I have been particularly indebted for advice and encouragement and to the former also for much help in working out various groups, which otherwise I certainly could not have attempted. Of those, who have their home in the islands, I owe much to the kindness of Messrs Francis Gay and Aubrey Robinson on Kauai, to Mrs Greenwell and her sons on Hawaii, and also to the late Mr R. Meyer of Molokai

[1] For a similar review of Aves refer to Vol. 1, pp. 368–465.

and the late Mr Valdemar Knudsen of Kauai, both of whom took much interest in scientific work. To numerous others, many alas! now dead, I am also indebted. Mr G. C. Munro, himself an ornithologist, gave me much assistance on many occasions and once or twice spent a day collecting with me. My friend Mr Albert Koebele, the only entomologist in the islands, during most of the period of my active collecting, accompanied me on several collecting trips and gave me many valuable specimens. Unfortunately for the most part he was absent on economic work in other countries. To the Hon. C. R. Bishop, the founder of the Bernice P. Bishop Museum in Honolulu, to the Trustees of the same, and to Dr W. T. Brigham, the Director, under whose guidance it has become a model institution, I am also indebted for help in various ways. Of recent years my colleagues in economic entomology have furnished me with specimens and information, and I have particularly made use of the observations of Mr O. H. Swezey, who has so successfully studied the life-histories of many of the larger and smaller Lepidoptera. The untimely death of my two assistants Messrs G. W. Kirkaldy and F. W. Terry, who were particularly interested in the Hemiptera and Diptera of the islands is much to be deplored. To Mr W. M. Giffard I am indebted for the gift of numerous specimens and the chance to examine many others, by which I have been enabled to gain additional knowledge on the variability of many species. From Bro. Matthias Newell I have received much help on many occasions, including the gift of valuable specimens. Mr Scott B. Wilson, who himself studied the Hawaiian Avifauna on various occasions, gave me much useful information, when I first left England for Honolulu, and other assistance.

General features of the islands.

The material collected by myself and others and described or enumerated in this work has been gathered almost entirely from the six largest and most lofty of the eight chief islands of the Hawaiian archipelago. The other two islands Niihau and Kahoolawe, each with an altitude considerably exceeding 1000 ft. above sea-level, have long since been denuded of their forest, having served as pastures for sheep and cattle. If any native fauna now exists on these, it must consist of very few species, and is not likely to be of any great importance. **Kahoolawe**, as seen from the island of Lanai, is often for days together, owing to the destruction of its vegetation, enveloped in clouds of red dust and may now be said to be blowing out to sea. It is no longer of any value even as a pasturage. **Niihau**, the most north-westerly of the main group, still supports large numbers of sheep. From Niihau to Hawaii, in a direction north-west to south-east, the main islands extend over a little more than five degrees of longitude.

North-west of Niihau is a chain of small islands, reefs, and shoals, continuing the archipelago west through 18 more degrees of longitude, the whole Hawaiian group covering some 1800 miles. These small islands have been to some considerable extent explored in search of birds, but very little is known of their other inhabitants.

Laysan, a low island, is remarkable for its Drepanid birds and various Noctuid moths, both clearly allied to species inhabiting the main islands of the group, while Midway also has produced a few insects allied to those on the larger islands. Both these islands, however, have yielded species with no allies on the main group, e.g. Laysan the small bird *Tatare familiaris* and Midway a species of true *Chrysopa* in Neuroptera and a Noctuid moth of the genus *Prodenia*. Laysan has for a number of years been worked for its guano deposits, and, more recently, a cable station has been made on Midway, so it is probable that both these islands are now, or soon will be, overrun with imported insects.

Niihoa or Bird island rising to an elevation of about 900 ft. is the most lofty of the smaller islands, and was visited by an excursion party some 25 years ago. Its geology was studied by Dr S. E. Bishop, but its zoology was neglected. No doubt it contained some much more interesting animals than the countless sea-birds that were noticed. The vegetation being dry was carelessly set on fire, and probably the most interesting part of the fauna was destroyed. It is known that there then existed a thick-billed Passerine bird, probably allied to *Telespiza* of Laysan.

Oahu, Plate V. Of the forest-bearing islands the one whose fauna has been most studied is Oahu. Here more than half a century ago Deppe and Townsend made an extensive collection of the native birds, at a time when these were evidently abundant, more numerous, as they state, than on the more northern island of Kauai. In more recent times the relative abundance of birds on these two islands has entirely changed, no doubt owing to the chief port and settlement of the group having become established at Honolulu on Oahu, and the greater and earlier interference with its natural conditions, that were brought about thereby. Blackburn's well-known researches on the insect fauna were mainly carried out on Oahu during the six years of his residence at Honolulu. Similarly the great variety of its land molluscs and the beauty of many of these have induced many residents in Honolulu to become collectors, either temporarily or continuously.

The area of Oahu is 598 square miles and for its size there is reason to suppose that it is or has been one of the richest of the group in its fauna. It is rather more than 70 miles from Kauai, at their nearest points, and 25 from Molokai. Like Maui and Molokai it is formed of a fusion of two islands. Of quadrangular shape the west side is occupied by the Waianae range, of much greater age than the longer Eastern or Koolau range, and, doubtless, existing as a distinct island long before the latter emerged from beneath the sea. The highest peak of the Waianae range is Kaala (4030 ft.). There are several large and deep valleys each containing a stream of water on its western side, and on the eastern side it is also much eroded into deep gulches and valleys. On this side its lower slopes are overlaid by the later lavas from the younger Koolau range, so that between the two ranges is an elevated plateau rising to nearly 1000 ft. above the sea. This plateau was once densely forested, but is now practically denuded, having served as pasturage for cattle, while more recently it has been partly put under cultivation for the production of pine-apples. The extent of forest on the Waianae range is now small, the introduced goats and cattle having been largely responsible for its destruction.

The Koolau range is much more heavily forested, though it has been greatly denuded during the last half century. The backbone of these mountains is much serrated, and the highest point Konahuanui, rather more than 3000 ft., lies a few miles behind the town of Honolulu, while there are several other peaks between 2500 ft. and 3000 ft. On the windward side for a long extent the erosion has been very great, forming perpendicular or very steep cliffs; on the leeward side the slopes are much more gradual, but are channeled by many valleys and gulches, which, in the more southern part especially, are often separated from one another by very narrow and sharp ridges at least towards their heads.

More recent than the Koolau range proper are some other craters, e.g. the Tantalus series, lying close behind Honolulu, and forming a favourite collecting ground, owing to their nearness to the city and easiness of access, while younger still are various isolated craters situated on or near the coast, e.g. Punchbowl, Diamond and Koko heads and others. Diamond head near Honolulu is interesting from the fact that it contains in a subfossil state great numbers of the shells of land molluscs, including several species of the Achatinellid genus *Amastra* and *Leptachatina* as well as *Succinea*, *Pupa*, *Eudodonta* and others. *Achatinella* itself does not appear to be found with these. A species of *Succinea* is still living there, but molluscs such as *Leptachatina*, *Eudodonta* and *Amastra* could no longer exist under the present dry and barren conditions. Formerly vegetation and moisture must have been very different to support these creatures.

Oahu, though the area of its forests is much diminished, is certainly rich in the number of species of the plants that compose this. The most extensive forest is found in the north-western area of the Koolau range. Parts of this area, however, appeared to me to afford much less variety in their botanical productions than the southern and more northern ends of the range. I have reason to suppose that the part of the range nearest to Honolulu (and containing, as has been said, the highest peak) has the richest fauna.

Kauai, Plate V, the most northern of the forest-clad islands, is separated from Oahu by a channel of rather more than 70 miles, where narrowest, a much greater distance than divides any other island from its nearest neighbour. It is of slightly less area than Oahu, and its outline is more nearly circular. The culminating peak is near the centre of the island, and is above 5000 ft. high. From this summit, Mt. Waialeale, and the adjoining plateau, valleys and gulches radiate to the coast.

As usual, erosion is very great on the windward as compared with the western side of the mountain. There are a number of constantly flowing streams of considerable size, some almost worthy of the name of river. As on Oahu and in fact on all the islands, the forests have been much denuded, but the central portion of the island is well-wooded. In some parts the vegetation is very varied, but in others at no great distance it is very uniform, and it is quite clear that causes quite apart from age may determine the variety or otherwise of the plants on different islands or on different parts of an island. The elevated plateau of the interior is for a large part of a boggy nature, and forms the main watershed of the island.

Niihau, the small island west of Kauai and now forestless (as has been already mentioned), was not visited by me. Shells of land molluscs of the genus *Carelia* have been found in a subfossil state there, indicating no doubt a once heavy forest and considerable moisture. It does not appear that the destruction of the forest has been recent, or that any considerable vegetation of larger growth existed at the time of Cook's arrival at the islands.

Molokai. Plate VI. East of the south coast of Oahu, and separated from it by a channel of about 25 miles, is the narrow island of Molokai, with an area of 261 square miles. Like Oahu and Maui it is formed of two distinct components, the western mountain or Mauna Loa, with an elevation of nearly 1400 ft., and the larger and more important eastern division with its highest peaks, Olokui 4600 ft. and Kamakou 4958 ft. Mauna Loa has for years been used as a sheep-pasture and is now almost denuded of native trees. No doubt before the advent of the white man it was fairly well forested, and the empty shells of dead Achatinellids of the genus *Amastra* have been found there, sure evidence of a condition of moisture that has passed away with its forest.

The eastern mountains have also been much denuded of their woods on the leeward slopes and for a large part not much dense forest remains except near the backbone of the mountain, where leeward and windward sides meet. On one large area fairly well covered with forest in 1893, but showing some signs of further deterioration in 1896, I reckoned that between the latter year and 1902 two-thirds or more of all the trees had died. This destruction was due to cattle and an introduced Japanese deer. The latter, indeed, became so plentiful that skilled hunters were brought from California to slaughter as many as possible. Both cattle and deer finally entered the wettest and densest parts of the forest, so that in 1902 the appearance of these was totally different from that which they presented six years previously. The Molokai woods have a fairly varied growth of trees and bushes in some localities, but there is an entire absence of Koa forest, and as the Koa (*Acacia koa*) is one of the most productive trees for the entomologist, a deficiency of species of insects is natural on this account. Evidently there was once a considerable growth of the allied *Acacia koaia* or of this and *A. koa* on the lower slopes, below 2000 ft., but these were at the time of my earliest visit mostly dead, and what remained alive were scattered trees, outside the limits of true forest, and quite unproductive.

On the north side of the island there has been much erosion, forming the deep valleys of Waikolu, Pelekunu and Wailau.

Lanai, Plate VII, is the smallest of the forest-bearing islands, and its highest point is 3400 ft. above the sea. The forest occupies only a small area of the whole island, in the neighbourhood of its highest ridge, above the Palawai valley. Cattle, sheep and wild goats have been responsible for this deforestation. It is quite obvious on examination that parts of the higher mountains of Lanai, though now much drier, were once of the boggy nature of the wettest parts of Molokai and other of the islands. A few of the insects peculiar to such boggy uplands still maintain their existence in spite of the drying up of the forest, but, doubtless, many have disappeared. I found a large variety of mostly small-sized trees in the remaining wooded parts of the island, but, as on Molokai, Koa forest is wanting. One feature in 1896 was the comparative abundance of the half-dozen species of native land-birds in this small patch of forest, their number being out of all proportion greater than that of the species on Oahu with its comparatively large forest area. The large Maunalei gulch on the north side contains the one permanent stream of water; in 1894 the forest on its sides had already been destroyed by wild goats, so that it was difficult and dangerous to descend into the upper parts of the valley from above, since, in climbing down, the bare rocks and earth were easily dislodged both by the climber and by the numerous flocks of startled goats.

Maui, Plate VI, a large island with an area of 728 square miles, lies east of Lanai and Molokai and is separated from these islands, at the nearest points, by channels of only about 8 to 10 miles in width. When standing in the mountains of Molokai above Kamalo and looking at West Maui it is quite easy, under favourable conditions of light, to distinguish several of the trees, which are chief components of the forest of the latter, the different colours of their foliage being obvious to the naked eye.

Maui consists of two geologically distinct islands united into one, the connection being a sandy isthmus. The west division is much older than the larger eastern mountain, but the connection between them does not rise to any considerable height above the sea (about 150 ft.) as compared with the intermediate plateau of the Oahuan ranges. Probably it has never borne more than a scrubby vegetation, and this fact is of importance in considering the means of distribution of species from Haleakala to West Maui and vice versa.

The highest altitude of West Maui is nearly 5800 ft., Eke with its boggy summit being about 1200 ft. lower. These high altitudes are usually wrapped in mists and rain; the ground, mosses and other vegetation are always saturated with moisture, so that, unless under exceptional circumstances, collecting in a general way is almost impossible. The streams issuing from these watersheds have eroded great numbers of gulches and larger valleys, the Iao, Waihee, Olowalu and others being conspicuous. The vegetation of the west and east side of West Maui is very different.

East Maui is formed of the great mountain Haleakala, the highest point being rather more than 10,000 ft. above the sea, and on the edge of the summit caldera. Owing to its altitude, East Maui differs essentially from any of the islands already mentioned in the fact that here for the first time we are dealing with a mountain, in which there is an extensive area above the limits of forest growth, while the summit is nearly devoid of vegetation. The bottom of the great caldera is about 7000 ft. above the sea and its sides are in some parts precipices of 2000—3000 ft. high. It contains numerous cinder craters, which are themselves five to nine hundred feet in height. The northern slope of the mountain is seamed with gulches, the forest-belt on that side intercepting the heavy rain-fall, while the western slope is dry and comparatively little eroded. This northern forest-belt differs much in the variety of its plants in different parts of its extension from west to east. In some parts during recent years many trees have died from a disease of obscure origin, so that fears have arisen as to the permanency of the watersheds, the water supply being of the greatest value for purposes of irrigation. On the drier western side the trees have been much destroyed by cattle, but on the windward side the growth of forest is extensive and in parts forms a very dense belt. Owing to its elevation, the summit of Haleakala is sometimes capped with snow in the course of the winter months.

Hawaii, Plate VIII, is by far the largest of the islands, its area being 4015 square miles, or much more than that of all the others together. Its northern extremity is 30 miles distant from Maui. It is of subtriangular outline and has been formed from five volcanic centres. Mauna Loa (13,650 ft.) and Kilauea (4040 ft.) are still active volcanoes, occupying with their slopes the south portion of the island, Kilauea lying east of the large mountain; Hualalai (8269 ft.), near the middle of the west side of the island, was last in eruption in 1801. Mauna Kea (13,825 ft.) is the most lofty of Hawaiian mountains, and is regularly snow-capped during the winter months. In the Hilo district its slopes bear a wide and dense forest-belt, though this has been lessened on the lower side by the cultivation of sugar-cane and other causes. North of this, in the Hamakua district, the belt of forest is much thinner, and some years since was considerably ravaged by fire. However, although much has been destroyed by cattle or cultivation, it may be said that all the districts, into which Hawaii is divided, still have extensive forest areas. In the variety of their vegetation these forests differ much according to locality, nor is an older part of the island always everywhere more rich than a younger one. Thus some parts of the older Mauna Kea are comparatively uniform in their vegetation, some parts of Mauna Loa well varied; but it is possible that the richest localities of Kea are richer than those of Loa, and the poorest of Loa poorer than the same of Kea.

In the northern corner of the island lie the Kohala mountains, much the oldest portion of the island, and which no doubt existed as a separate island long prior to the emergence of the other volcanic centres. These mountains rise to an elevation of five and a half thousand feet, and on the windward side are covered from the coast-line to the boggy summit with a dense and very humid forest. On this side are the large, deep valleys of Waipio and Waimanu, due to erosion.

There is no real break between the forests that clothe the different mountains of Hawaii, but all are or have been in some parts continuous, so as to allow of a ready passage for their denizens from one mountain to another. Doubtless, owing to the destruction wrought by man and his imported domestic animals during recent years, there are now large areas treeless or nearly so, where before continuous forest existed and made the connection still wider. Between the Kohala mountains and Mauna Kea are the uplands of Waimea, which have long been used as a pasturage for cattle to the detriment of their native vegetation. Between the three great mountains Loa, Kea and Hualalai is a vast arid tract reaching an elevation of over 6000 ft., of excessive roughness, being traversed by many lava flows from Mauna Loa.

The maps of the islands, which we have been permitted to reproduce by the kindness of Mr Willis T. Pope, Superintendent of Public Instruction in the islands, give a good general idea of the rough and broken character of the ground over which most of the collector's work is done.

A map showing the relative positions of the Islands was issued with Part 1, Vol. I of this work.

As a group the Hawaiian islands are amongst the most isolated portions of land surface. The main islands are placed a little within the tropic of Cancer or in the same latitude as a middle strip of Mexico. They are much nearer to the North American continent than any other, the coast of California being distant about 2100 miles, the portion of Mexico, above mentioned, being considerably more distant still. On the west Hong Kong is in the same latitude. Almost south of the group, the Samoan and Fijian groups, the only islands of considerable size, are 30 to 40 degrees distant. Between these and the Hawaiian group lie a number of small islands, but the nearest of these, Palmyra (5° 49′ 04″ N.), is very remote and separated by an enormous depth of ocean. The extreme outlying islands (Midway, Ocean, etc.) to the N.W. of the archipelago are equally separated from other lands.

The general features of the Fauna are somewhat similar to those of Madeira and the Canary islands and to New Zealand, but in details they are very different from any of these. Tahiti and the Samoan group are not sufficiently well known to make any comparison of much value.

Owing to the mountainous character of the islands there is great diversity of climate in different localities. The prevalence of the trade-winds through a great part of the year causes much heavier precipitation on the windward side of the islands, while on the lee side, though the mountains may have copious rains daily, the coastal region gets little or none of these. The region of heaviest precipitation, whether on windward or leeward side, is generally from 1200 to 5000 ft. above sea level, or corresponds with the region of dense forest.

The temperature at the United States Weather Bureau Station in Honolulu for the years 1905—1909 is recorded as follows:

	1905	1906	1907	1908	1909
Highest shade temp. (Fahr.)	84°	85°	86°	85°	84°
Lowest temp.	57°	57	62°	61°	56°

On the lowlands a temperature of 90° or even more is occasionally but very rarely noted, and one as low as 52° rarely occurs.

The decrease of temperature with elevation is reckoned as 1° F. for each 320 ft. of ascent in the mountains.

At the U.S. Weather Bureau Station the annual rainfall in Honolulu for the five years above quoted was 16·99, 25·77, 30·13, 19·17 and 20·81 inches, while in some coastal localities the rainfall would be considerably less. A few miles behind the town the rainfall is much heavier; thus on Mount Tantalus, in 1905, at an elevation of 1300 ft. it amounted to 99·68 inches, while on the ridges behind Tantalus it would have been much heavier still—probably twice as heavy—since they precipitate much of the rain before it reaches the Tantalus group. In a wet district, such as windward Hawaii, the rainfall for the same five years at Hakalau in the Hamakua district at an elevation of 200 ft. was 167·59, 122·80, 182·60, 147·19 and 152·54 inches, and a few miles above, at 1200 ft. elevation, it was much heavier still, 260·67 (1907), 206·33 (1908) and 233·75 (1909).

In 1907 (a year selected at random) at Waiakea (50 ft.) in the Hilo district of Hawaii it was rainy on 333 days; at Waianae, a very dry district of Oahu, on 60 days of the same year.

As by far the greater part of the Fauna has its home in the wet-belt or forest-belt it will be easily understood that any particular collecting trip can be, and often is, very seriously interfered with by climatic conditions. On the high mountains of the Kona side of Hawaii, there is (where it has not been destroyed) a very dense forest-belt with heavy rainfall and a much drier but well-forested region above this. Something like this is also found on the windward side, but there is this great difference, that, on the latter, the region below the forest enjoys a large rainfall, while on the Kona side the lower slopes and coastal region are for the greater part of the year extremely dry and parched up.

In the winter the highest mountains of Hawaii and less frequently Haleakala on Maui are snow-capped, the snow sometimes extending down into the forest-belt. Frost is rarely observed below 4000 ft. even in the winter months. In Feb. 1902, in some more or less open forest land on Molokai at 3000 ft. the ground was white with hoar-frost on several consecutive days, and all the tender pink-coloured terminal leaves of *Myrsine* were blackened and killed by the cold. In the denser forest at a higher elevation no such effect was visible, and no signs of frost were seen there on these days. When one is camping in the rain-belt and in search of creatures, for successfully collecting which a fair amount of fine weather is essential, it is very tantalizing to see the lowlands blazing in the sunshine, while the forest-belt day after day is wrapped in fog and rain.

General aspect of the Flora and Fauna.

The fauna of the islands is necessarily so intimately connected with the peculiarities of the flora, while the peculiarities of the latter are in like manner sometimes evidently connected with the remarkable characters of the fauna, that some consideration of the vegetation of the islands is necessary. Every student of the natural history of the islands is much indebted to the late Dr W. F. Hillebrand, whose "Flora of the Hawaiian Islands" has proved a most valuable work. In some introductory remarks, which he did not live to complete, he cites 860 species of Phanerogams and Vascular Cryptogams as natural immigrants or as peculiar to the islands, after deducting those introduced by man since and before the discovery of the islands by foreigners. Of the 860 species 653 are endemic (or 75·9 per cent.) and 250 of the species belong to 40 endemic genera. Of Phanerogamous plants 81·4 per cent. are endemic, of Dicotyledinous 85·6. Since Hillebrand's work, as is natural, additional species have been discovered from time to time and some changes have been made in the number of the genera that are endemic, but until the completion of the study of the flora by botanists of to-day the above figures may be accepted. From my own observations I have reckoned that the endemic plants, given as 653 by Hillebrand, are probably not more than two-thirds of those that exist. This reckoning is made from the considerable number of species, not included in Hillebrand, that I have casually observed, when investigating the fauna, and on the consideration that the systematic botanist would generally speaking adopt Hillebrand's views as to specific characters. It is clear that the additions to the list of endemic plants will be mainly in an increase of species allied to those already known, rather than in the discovery of striking new forms. In other words the general features of the flora are adequately known.

Owing to the mountainous character of the islands, with great differences in rainfall and temperature at different altitudes, the flora varies very greatly at different heights on the mountains.

Littoral plants are very poorly represented, mostly by natural immigrants of wide distribution elsewhere. Many of these have fruits or seeds that float for long periods, and have no doubt reached the islands on ocean currents. A few only are endemic, e.g. the parasitic dodder (*Heliotropium anomalum*) and species of the Composite genus *Lipochaeta*. The littoral insect fauna (excluding foreign forms) is likewise poor, and most of the species that are attached to the coasts also range inland over the plains or ascend the dry and bare lower slopes of the mountains. They are xerophilous rather than strictly littoral, and some of them even reappear in the dry open country above the forest-line and rain-belt, even at elevations above 7000 ft. Some, however, if not absolutely confined to the region of littoral plants, yet never wander far inland. These include a number of endemic bees and wasps, which visit the flowers of such plants as *Vitex trifolia, Scaevola koenigii, Tribulus, Waltheria* etc., the wasps finding their prey amongst these and other sublittoral vegetation, such as species of *Sida, Lipochaeta* and foreign weeds. The Otiorhynchine beetle *Rhyncogonus vestitus* is attached to *Vitex*, the endemic moth, *Pyrausta litorea*, to *Scaevola*, while the caterpillars of a few Noctuid moths and some Hemiptera (both Heteropterous and Homopterous) feed on grasses and low flowering plants that grow in the sand. On the whole the littoral fauna appears to be at any rate less poor than its flora.

On the leeward side of the islands, owing to the comparatively small amount of rainfall and (usually) the absence of any heavy rains during the greater part of the year, the vegetation of the coastal region and lower mountain slopes is for the most part dried up, and only after heavy rains does the verdure reappear. At the present time, however, numbers of xerophilous plants, introduced by man, do much to lessen the arid appearance of the lowlands. Chief of these is the algaroba or mesquite (*Prosopis*), the most valuable tree ever imported into the islands. In some of the driest coastal districts it now forms quite a forest-belt, affording food and shelter to cattle and other animals, and an abundance of excellent firewood. An *Opuntia* of very early introduction, a mimosa (*Acacia farnesiana*) and *Lantana camara* are very conspicuous and to the stranger might have the appearance of being really native.

Most of this region and the mountain slopes that lie below the forest, where they are not under irrigation or cultivated, have for years been grazed over by cattle. This region is also overrun by foreign weeds, imported by man, and little is left of the native vegetation. Where there is a covering of grasses, these are generally foreign. However, in the most arid districts of the islands, where foreign weeds have failed to establish themselves to any great extent, or at least do not thrive, and on some of the rough lava flows, avoided by the cattle, a considerable number of native shrubs and trees may still be found. In a few places on these dry mountain slopes there yet remain a few choice endemic plants, now mostly extremely rare, such as the red-flowered cotton tree (*Gossypium drynarioides*) and the shrubby violet (*Viola helioscopia*). Though so greatly denuded, here and there, either singly or in clumps, we meet with various endemic or immigrant species of interest, e.g. *Maba, Santalum, Nothocestrum, Gardenia, Nototrichium, Dodonaea* and *Erythrina*. *Pandanus odoratissimus* grows scattered or in thickets in many places, and groves of bread-fruit trees occur rarely, as evidence of former cultivation.

A number of plants of aboriginal introduction belong to this region, but all of them more or less frequently extend upwards till they form part of the regular forest. The Hau tree (*Paritium tiliaceum*) thrives equally near the sea-coast and above 1000 ft. elevation in the mountains, where it sometimes forms impenetrable thickets. *Aleuritis triloba*, the candle-nut tree, and *Eugenia malaccensis*, the so-called 'native apple,' are most partial to the valleys, the former in some localities extending upwards to an elevation of 3000 ft. or more, the latter attaining only about half that height in the mountains. Both, but the former more especially, may form an important element in the true forest-belt, so as to have the appearance of indigenous plants. Their foreign nature, apart from other considerations, is evidenced by the absence of any special fauna in connection with them. Neither of them are unsuited as pabulum for indigenous insects, since some of the polyphagous species feed upon them and especially on the *Aleurites*, but they have no special fauna. With these the 'Ki' or 'Ti' (*Cordyline*) is often very conspicuous. Apart from these aboriginal introductions, as one ascends the lower slopes or valleys and there is an increase in the rainfall, the introduced guava may occupy the whole soil to the exclusion of all other trees or shrubs. Where the moisture is sufficient, the foreign grass, *Paspalum conjugatum*, commonly known as 'Hilo grass,' from the fact that it first appeared in that district of Hawaii, covers the whole ground; or in drier localities other equally indifferent grasses are in occupation.

There is no doubt that what one now sees on the dry lower slopes of the leeward side of the islands is but a remnant of a once more or less open forest land, which has had a very special fauna of its own. In addition to the trees already mentioned some of the more common components of the present continuous forest-belt extended down into this region, *Acacia koa* and *Metrosiderus* for instance. Only in special localities can one now get a glimpse of this fauna, for excepting a few wide ranging or hardy species, or such as are specially protected, all the native insects of this region have been destroyed either by imported predaceous insects or by the destruction of the forest itself, and the changes of conditions that have ensued. In a few spots there yet remain in Lepidoptera species of *Scotorythra*, *Talis*, *Thyrcopa*, *Hodegia* etc.; in Coleoptera *Plagithmysus* and special species of *Rhyncogonus*, *Proterhinus* and *Labrocerus*, together with some Hemipterous insects, Jassids and Fulgorids, quite peculiar to it. The loss of all but a remnant of this, no doubt, once rich and extensive fauna is much to be regretted, for it may be suspected that here some of the finest native species once occurred. Passerine birds regularly descended into the clumps of trees of this open country, as in fact we have ourselves noticed in special localities in past years. From these, in Cook's time, they passed still downwards, since we are told that several species were found frequenting the coconut palms on the beach. Achatinelline shells as well as other land Mollusca were no doubt numerous, in the upper part at least, of this region.

It is certain that in prehistoric, but comparatively recent times, the climate and vestiture of the lowlands of some of the dry districts of the islands must have been very different from the present condition. Thus at the base of the cone of Diamond Head on the coast a few miles S.E. of Honolulu are found extensive deposits of many species of land Mollusca (*Amastra*, *Leptachatina*, *Endodonta*, *Succinea* etc.), the species differing little, if at all, from those now living in the forest-clad parts of the Oahuan mountains. Similar deposits are found on the leeward side of the Waianae range at no great elevation above the sea and in various other localities. Such places are amongst the most arid to be found on the island at the present time. While *Succinea* can be found living near the coast in the driest localities, most of the other genera can thrive only where there is a liberal supply of dampness, and where the vegetation is dense enough to retain this. It is very important to remember that such different conditions have existed in past time, when one considers the possibility of the survival and establishment of any chance immigrants that may have reached the shores. Where the immigrant would now find a barren and arid region on its arrival, very different conditions may have existed in other times.

Above the lower dry mountain slopes, at elevations varying usually from 1200—3000 ft., one reaches the belt of continuous forest. Where undisturbed by man or beast, this is often so dense as to be impenetrable without cutting a pathway, or at least breaking through by force. Luxuriant growths of Ieie (*Freycinetia*) in many localities and in others wiry-stemmed ferns (*Gleichenia*) make progress difficult. The width of this forest-belt varies very greatly according to the locality and according to the destruction that has been the work of man. In some places no such forest-belt exists, in others it has been reduced to an open timbered country, covered with foreign grasses. This is the last stage preceding destruction, when the remaining trees produce their seed in vain, for the thick growth of grass prevents any young trees springing up to replace the old. We have known a forest so dense that it could be traversed only along a narrow made path, generally knee-deep in mud, to be reduced to open woodland by the ravages of cattle within a period of about fifteen years.

On Oahu (and elsewhere) the lower part of this forest consists or in past time has consisted to a large extent of the fine and valuable Acacia, *A. koa*, which altogether fails or becomes sparing in the highest forests of this island. On some of the islands (Molokai and Lanai) there is now no Acacia forest, though evidences of its former existence still remain. On the lofty mountains of the other islands the Koa may extend throughout the whole forest-belt, but it is wanting over extensive areas from natural causes. The Ohia, *Metrosiderus*, is the commonest of all forest trees extending both above and below the region of dense forest, and is the main constituent of the forests throughout the whole group of islands. It is extraordinarily variable, and can adapt itself to the most varied conditions of climate and station, to an extent indeed of which the Koa seems quite incapable. From one of the largest of forest trees it may become, on boggy mountain tops, a trailing shrub, or a small erect plant with simple stem no thicker than a pencil and bearing a single large terminal flower. Its variations under more normal conditions are very great, and it is presumably the parent of the other species of its genus that are considered distinct and endemic. Both the Koa and Ohia are of great importance to the fauna, since hosts of creatures are dependent on them. The former probably supports the larger number of peculiar forms, of which, no doubt, many have been exterminated by its extensive destruction. Throughout this forest-belt ferns, both epiphytic and terrestrial, are most numerous and varied, often covering the whole surface of the ground beneath the trees or clothing the trunks of the latter. Here the tree-ferns acquire their greatest size and beauty. The fauna connected with ferns is quite rich, not only tree-ferns but the lesser species also yielding their own peculiar insects. In the Rhyncophorous beetles a number of species of *Proterhinus* are restricted each to a particular species of fern, and tree-ferns support *Heteramphus* and *Dryophthorus*. Small crickets of the genus *Paratrigonidium* affect each their own special ferns, as do some Hemiptera (Heteropterous and Homopterous) and larvae of various Macro- and Micro-Lepidoptera feed only on these. Tree-ferns are a favourite resort of numerous Carabid beetles, and the dead fronds are the home of *Machilis* and many other creatures. It seems probable that in the islands the fauna attached to ferns is proportionately much more extensive than one usually finds to be the case elsewhere. For this reason some of the endemic birds are constantly to be found seeking for food on the stems and amongst the fronds, and some of the land Molluscs are also very partial to them.

It is not necessary to give a list of the trees and shrubs that form this compact forest-belt, for herein are found species of nearly all the important genera of plants, while many are altogether confined to it. Its components are very different in different localities, the difference depending in many cases on the nature of the soil or of the rainfall. In drier localities one will sometimes find a less dense and more varied forest than in a closely adjoining and wetter district, or a wetter part of the belt may be more varied in its vegetation than that at a higher elevation and with a lesser rainfall. Apart from the Ohia and Koa already mentioned the following are very important trees or shrubs to the student of the fauna: the arborescent Lobeliaceae, the Rutaceous *Pelea* and *Zanthoxylum*; *Cheirodendron* and other Araliaceae; the *Rubiaceae* generally; *Pipturus* and other *Urticaceae*; *Myrsine* (Myrsinaceae), *Broussaisia* (Saxifragaceae), *Elaeocarpus* (Tiliaceae), *Perrottetia* (Celastraceae), the Leguminous *Sophora chrysophylla* and an endemic *Rubus*. However, most trees and shrubs of this belt are more or less productive, and one may add to the above *Eugenia sandwicensis*, the numerous species of *Pittosporum*, *Santalum*, *Myoporum*, *Nothocestrum*, *Charpentiera*, *Pisonia* and the arborescent or woody Compositae.

On the highest mountains towards the upper limits of the forest there is often a very uniform flora, rich nevertheless in species of birds and insects. *Acacia koa*, *Sophora chrysophylla*, and *Myoporum sandwichense* sometimes form its chief components. Lower down *Metrosiderus* interspersed with lesser trees such as *Myrsine*, *Gouldia*, *Straussia*, *Pelea* and arborescent lobelias may be dominant. Naturally two such localities though adjoining one another have a vastly different fauna. Of the lesser plants found within the forest-belt, violets with woody stems, a giant *Gunnera*, the pink-flowered begonia (Hillebrandia), the liliaceous *Astelia*, and some of the endemic Labiates are the most likely to attract the attention of the non-botanist. On the summits of the lesser mountains (those not attaining 8000 ft.) there is sometimes developed a bog-flora, characterized by species peculiar to itself. Bog moss, endemic sedges, grasses, violets, *Drosera* and creeping and woolly forms of plants elsewhere erect and glabrous are characteristic. Such bogs are more or less evident on all the forest-clad islands, excepting Lanai, and even there one can see signs that such a condition formerly existed.

On the highest mountains of Maui and Hawaii the forest fails long before their summits, often snow-clad, are reached. Above its upper limit dwarf trees and bushes are found with ferns and grasses to which a drier climate is congenial. *Sophora*, *Santalum*, *Myoporum*, arborescent or shrubby Composites are common constituents, while the Epacridaceous *Cyathodes* and *Vaccinium reticulatum* cover much ground. Some of the endemic species of *Geranium* attract the eye by their silver foliage, while the silver-sword *Argyroxiphium*, a handsome and peculiar Composite, is found as high as 12,000 ft. A somewhat similar vegetation is found in some localities within the limits of the forest-belt, where extensive open lava fields occur and there is a lack of permanent moisture.

On the windward side the forest-belt on some of the islands has suffered less destruction than on the lee side and, if quite undisturbed, it still extends downwards to the cliffs that fringe the shore. Where the coast is not bounded by cliffs the lower slopes are usually denuded, but owing to the rainfall are green throughout the year and well covered with vegetation. The native fauna, however, as on the dry side of the islands has been mostly destroyed by change of conditions and the predominance of imported predaceous insects. The fauna of the windward side is, I think, contrary to what one might expect from the condition of the vegetation, poorer than that of the dry side, although the forest-belt (as on the slopes of Mauna Kea above Hilo) here reaches its greatest development. Wherever I have investigated, this is certainly the case so far as Coleoptera are concerned. However in the rain-soaked woods of the windward forests Lepidoptera are particularly abundant, as also are some Diptera, and the beautiful condition in which one finds the most delicate and minute moths, during the frequent torrential downpours is frequently a matter for wonderment. In such places more hardy insects, such as *Pyrameis tammeamea* and *P. atalanta*, *Deilephila wilsoni* and others, pay little attention to the heavy showers and may be seen active under such conditions during the day time, while moths in general are equally so after dark.

It is not necessary to give any special list of the fauna of the true forest-belt.

Herein probably nineteen-twentieths of the endemic species now existing have their home. Here will be found all the genera and species of Passerine birds and nearly all of the land Mollusca, especially the Achatinellidae. Very rarely do these latter pass above the 4000 ft. line above sea-level and then only in the case of a few species of one or two genera or subgenera. Other creatures appear similarly to keep within certain bounds as to elevation, the crickets of the genus *Paratrigonidium* and *Banza* (*Brachymetopa*) rarely passing the line just mentioned in spite of the continuity of the forest upwards. Unless the woods have been opened up by man or cattle, wasps fail to establish themselves in the wettest and densest of these. In some localities xerophilous insects and plants pass through dense and wet forests by means of the recent bare and open lava flows, which cannot retain moisture.

Above the forest-line on the highest mountains in the open country there is an insect fauna of species peculiar to the region, but it is very meagre as compared with that of the forest immediately below. This could scarcely be otherwise considering the limited character of the flora and the fact that so many of the insects are strictly attached to arboreal plants. Nevertheless, it is now a much more productive country than most of the open region below the forest, for the reason that its fauna has not been destroyed by introduced predators. In particular its species of Carabid beetles remain abundant up to an elevation of nearly 10,000 ft.

Wherever the soil and other conditions are suitable a great deal of the lowlands and lower mountain slopes are given up to the cultivation of sugar cane, which on the dry side of the islands is grown under irrigation, but in wet districts usually finds sufficient moisture in the rainfall. For the sugar plantations of dry districts water is procured either from the mountain streams directly, or by tunneling in the mountains, or by pumping from artesian wells on the lowlands or at low elevations. Where cane is not grown either for lack of water or other reasons, the land is often overrun with cattle both above and below the forest and in many cases the forest itself is invaded. Fortunately now that it is realized how cattle inevitably destroy all Hawaiian forests and cause the drying up of the watersheds, on which the entire prosperity of the islands depends, large areas of woodland have been reserved and all cattle excluded. Though this exclusion has not been carried out nearly as rigidly as one might wish yet there is reason to believe that what has been done and may still be done in this matter will preserve a great part of the endemic fauna and flora for future generations. Only the small islands of Kahoolawe and Niihau are beyond redemption so far as native vegetation is concerned.

Leaving out of consideration all foreign plants, whether imported by man or naturally immigrant, the lack of conspicuous flowering plants is a most striking feature not only of the forest but of the open country. Were it not for the natural immigrant, *Metrosiderus polymorpha*, the chief constituent of the forests, the latter would be sombre indeed. This tree with its abundant red flowers, when, as is often the case, it comes into blossom over large areas at the same time, presents a really bright appearance, and this effect is heightened by the large numbers of the common scarlet and crimson Drepanid birds that resort to the flowers for the sake of their abundant nectar. It is true that there are some other flowers, such as *Gardenia*, that are conspicuous and fragrant, or showy like the native species of *Hibiscus* and the begonia, *Hillebrandia*, but these are too local or infrequent to change the general impression. In open places the yellow flowers of some of the gregarious Compositae attract the eye, but in other countries would hardly be noticed as being more than a rather superior weed. *Freycinetia* in flower or fruit has for a short season a bright appearance, though in many districts nearly every one is devoured or befouled by foreign rats. Perhaps after *Metrosiderus*, the Mamani (*Sophora chrysophylla*) which grows gregariously and also attracts the red birds, makes the best show. Of the arborescent lobelias the flowers, though often large and numerous, are rather strange than beautiful; in many species they are hidden beneath or amongst the foliage and often they appear to decay almost before they are fully mature. On the other hand the ferns with a large variety of species, often of considerable beauty, are the more attractive from the absence of conspicuous flowering plants. Nowhere in the islands will one find any display of the latter comparable with that which is so usual in the meadows or open woodlands of countries outside the tropics.

Having spoken of the general inconspicuousness of the flowers and the bright colours of some of the commonest birds, we may notice the general aspect of the fauna. The greater number of species of the native birds have green, yellow or olivaceous plumage and are not conspicuous, though some of them are of strange or even grotesque form. Here belong the Drepanididae, but five genera (at least in some of their species) have red plumage either in both sexes or at least in the male. The Meliphagine *Acrulocercus* have mainly black or dark plumage, as do several of the Drepanididae, but none are entirely black, since red, white or yellow forms part of the colour pattern. The thrushes (*Phaeornis*) are of sombre colours, but the males of the fly-catchers (*Chasiempis*) are often prettily variegate.

The absence of gaily coloured native butterflies or diurnal moths prevents the insects from making any conspicuous showing. It is doubtful whether to ordinary observers there is, excepting the fine *Pyrameis tammeamea*, a single insect that would be considered beautiful. At least that species only can be said to represent brightly coloured insects in the way that *Vestiaria*, *Himatione* and others do the birds. The vast majority of the insects are utterly inconspicuous and unnoticed unless specially sought for. In most places, whether in forest land or in the open, one will observe the endemic bees or wasps, insects of small or medium size, mostly appearing black in life, and the species very uniform in general appearance. Their great abundance in many places, the dark, blue-shining wings of many of them and their activity by day attract our attention. In many woodlands and by the side of mountain streams some of the larger red-bodied dragon flies of the family Agrionidae may even be called conspicuous, while others like *A. nigrohamatum* have a remarkable appearance as they fly towards one, owing to the bright yellow colour of the face and the striking turquoise-blue of the eyes. Apart from these it is quite possible for the casual observer to walk through miles of forest and see not a single even moderately conspicuous insect. At the most, moths of insignificant size and appearance are frequently disturbed from tree-trunks or undergrowth, as he walks along. These remarks, it should be understood, will apply to localities, where there is in reality a rich endemic insect fauna, and serve to show its hidden nature.

The arboreal species of Achatinellidae, though not large, are many of them of very bright colours and even beautiful, but in the woods they are far from conspicuous. It is easy to imagine that any one not specially searching for these, or for other creatures in the same habitat, might pass them by daily without being aware of their existence. Even in the wettest weather they do not move around by day with the freedom of many land Molluscs of other countries. The terrestrial species are of sombre colour and well concealed, as also are many of the species which habitually frequent the trunks and branches of trees rather than the foliage.

The endemic spiders are mainly inconspicuous and many of the forms that frequent the trunks and branches of trees match their environment so well as to be nearly invisible. Others remain hidden beneath bark or between leaves spun together. Web-making species are often numerous in shallow caves or hollows in the sides of mountain ravines, or in the cavities of old tree-trunks, or they spin their webs near to the ground. Being so favourite a food of the Passerine birds, the arboreal forms especially, were they not well concealed by day, would have had little chance of survival. The great decrease in the number of native birds may well lead to an increase in the number of spiders, even if it has not already done so. Certainly, in 1892, individuals of the species living exposed on the limbs of trees on Hawaii, where birds were very numerous, were most uncommon.

Account of time spent in collecting and methods employed.

Before beginning a more special account of the Hawaiian Fauna it seems advisable to refer to the time that has been spent on the various islands of the group in collecting material. I arrived in Honolulu early in 1892 and during the spring months collected chiefly in the Waianae range of Oahu, partly on the eastern and partly on the west side of these mountains, but more successfully on the latter. Except for an odd day or two I did not attempt the Koolau range, which was the scene of most of Mr Blackburn's entomological field-work. Throughout the summer I was stationed on the west side of Hawaii, working chiefly on Mauna Loa, then a paradise for native birds, and to some extent on Hualalai. Collecting was done at all elevations from the dry coast, through the wet-belt, where heavy rain fell almost every day, to the higher and drier forest of 4000 ft. and upwards, and to the summit of Hualalai. The winter months of 1892—1893 were spent almost entirely on the western slopes of the Northern end of the Koolau range of Oahu, where the forest-belt was more extensive than elsewhere. This part of the range appears to me to be decidedly inferior for general collecting as compared with the Honolulu end, at any rate during so wet a winter as was this one, but here, if anywhere, there seemed to me to be a chance of meeting with certain birds, of which it was specially desired that specimens should be obtained. However, neither the 'Oo,' *Acrulocercus apicalis*, nor the species of *Hemignathus* and *Heterorhynchus* peculiar to the island and obtained by early collectors in the first half of last century, were to be found, either by myself or other ornithologists, and it may be that they had already become extinct there. This, with perhaps one or two exceptions, was as unsuccessful a collecting experience, as I ever met with.

In May 1893 I crossed over to Molokai and, the west half of the island being practically forestless, camped on the southern slope of the forest-bearing end, near the middle of the island. All animal life seemed abundant after my experience on Oahu. Common species of birds were plentiful, though not in the extraordinary numbers observed on Hawaii, and of course all the Mollusca and most of the insects were new to me. This was a very wet summer in the mountains, and for the first six weeks there was hardly a day without long and heavy rains in the woods a few miles behind my camp, and when it was not actually raining, these were mostly enveloped in thick fog, through which objects were visible only for a short distance. In spite of this, collecting was good. After a time I pitched a tent in the midst of the highest boggy forest near the back ridge of the mountains. From my different camps I was able to get to Kalae on the west, where I also made a short stay, to the valley of Waikolu, and down into the deep valley of Pelekunu, where I stayed for a time in the then native village on the windward coast. It was not till the autumn that I was able to leave Molokai, owing to the large amount of time spent in securing the rarer birds. And here I should state, that not only on Molokai, but elsewhere the scarce birds are without doubt difficult to get even in moderate series. I should consider that, both on Molokai and other islands, at least half of my whole collecting time was taken up in acquiring those that I obtained. For some of these birds it was necessary to be continually on the watch, and even then, and in the best localities, it was quite possible to spend weeks without seeing, or even hearing, a single individual. For this reason, until I had secured my specimens, I never dared to go about unhampered with gun and other necessaries for bird-collecting, even though I was specially in search of insects.

When it is considered how small and well-hidden are most of the latter, it will be easily understood that the many days spent specially in search of rare birds, for which both sight and hearing need to be kept constantly strained, did not result in a great accumulation of entomological specimens.

After my experience of the previous winter I concluded that it would be better to spend this season on the small and comparatively dry island of Lanai, the forest area being very small. Nearly all my extensive series of Lanai birds, shells and insects were obtained during these months. In March 1894 I proceeded to Maui, working with not too much success in the broken West Maui mountains, where I have invariably had bad luck from weather or other causes, and with satisfactory results on Haleakala. As I was returning to England for the winter I was unable to make a stay of more than two months, after which I went to Kauai and collected over the high plateau of the middle of the island and also to some extent on the lower and drier parts of the mountains. During this summer I revisited Lanai for a short period of camping and finally proceeded to windward Hawaii for a brief stay. At the end of the summer I left for England and for four months was engaged in working on the specimens, so far collected, and described the bees and wasps that had been obtained, this latter work being revised subsequently and published much later.

In the spring of 1895 on my return to the islands I first made a lengthy stay on Kauai, visiting various parts of the islands and afterwards went to Hawaii, collecting in the Hilo, Puna and Kau districts. In the winter months several camping expeditions were made on Mauna Kea, birds being the chief object. On two of these expeditions there was not a single day without heavy rain and the collecting was very trying. On account of the density of the forest, I had a gang of natives with me, in order to cut trails through the forest. They all suffered much from the wet and cold, it being impossible to dry clothes for sleeping in, and one of them met with a bad accident. On my last attempt, however, I had exceptional weather for two weeks and secured the bird I chiefly wanted, and some rather nice insects. In February 1896 I spent some time in a tent on the Waianae mountains, at a higher elevation than had been possible in 1892, and afterwards revisited Kauai (more than once), Molokai, Lanai, Hawaii and Maui. One of the Kauai expeditions, when I camped on the wet side of the island, was very poor in results, but other localities yielded well. In January 1897 some time was spent in collecting on the west side of the West Maui mountains, but this collecting was done under many difficulties. Leaving Maui, I camped out for some weeks on Kauai. Shortly afterwards I left for England by way of Arizona and Mexico. After working on the collections and completing the descriptions of Hymenoptera already referred to, as well as the Neuroptera, Orthoptera and some families of Coleoptera, I returned to the islands early in 1900. In this and the following year my work was almost entirely confined to Oahu. I rarely carried a gun, and paid little attention to anything but insects and mostly limited my observations to certain groups of these. Very little indiscriminate collecting was attempted. Beetles such as are easily obtained by indiscriminate beating of trees or by sweeping these, were almost all collected by special search, as I wished to obtain a more certain knowledge of their habits and particularly of the restriction of species to one food-plant, the variation of individuals found in company and that of different colonies. Practically all the specimens obtained were mounted, when freshly killed, and to a large extent examined at the time. Observations were made in widely separated localities and in both mountain ranges. During this period I had facilities for working at the specimens in the office of my friend Mr A. Koebele, the Government entomologist of the islands, who accompanied me on a number of my trips. Although, as has been said, my latter work was of a more special nature, yet more new species than might have been expected were obtained. The time spent by me in general collecting (i.e. excluding my last mentioned visit to the islands) did not differ much in the case of the four islands Kauai, Maui, Molokai and Oahu, averaging about eight months to each. On Lanai the small size of the island and its few species of birds only necessitated about four months work, but the great island of Hawaii consumed about twenty months, largely on account of its richness in species of birds, as compared with any other of the group.

All my collections were specially packed and shipped in Honolulu, and although practically all the Lepidoptera and many of the other insects were pinned, and must have received much rough handling in their several changes from steamer to train and vice versa, I think hardly a specimen was damaged or even shifted. A single lot unwisely sent by mail, for a special reason, was considerably damaged.

In 1902 and 1903, having ceased to collect for the Committee and become engaged in local economic entomology, I was able to visit several of the islands and collected a great deal of material, some of it still being unworked or undescribed, while some of the species are included in the systematic portion of this work. In 1902 I made an extensive investigation, by breeding them, of many of the parasitic Hymenoptera and in 1903 I paid a good deal of attention to the native leaf-hoppers (Homoptera). My account of the birds was published at the end of 1903 (Vol. I, p. 365). After this date except for occasional single days or for short periods I have done little field-work, and when working have nearly always had some special object in view, rather than to collect indiscriminately. Though greatly occupied with economic entomological work I completed the Anobiidae (published in 1910), a group of beetles on which I had been occupied, as occasion offered, for about ten years, and wrote supplementary papers on other Coleoptera and several of the other Orders. As to the groups of insects, which have been worked out for the Committee by well-known specialists, in most of these I have had occasion to determine large numbers of species, or even considerable collections, the material having been collected both by myself and others. I have thought it advisable to refer at this length to such work as I have personally done in connection with the Hawaiian fauna, both in the field and study, because on this are based the conclusions that I have arrived at in this Introduction. From observations of a less wide nature or limited to a single group I might have arrived at other conclusions.

It has already been said how much time was taken up in the search for some of the rarer birds and in the acquisition of a good series of specimens of these. As to the insects far more time was given to a special search for Coleoptera than any other Order. After the beetles the Microlepidoptera probably occupied the most time. Many of these were collected in very wet and sometimes windy localities and as they could not be carried alive in so rough a country without damaging themselves, I found it necessary to kill and pin them, as soon as they were caught. Liquid ammonia was always used in killing, except for stray specimens picked up, when I was specially in search of other insects or of birds. It was often necessary to carry an umbrella in order to obtain shelter from the wind and rain, when pinning the specimens in the field. On comparatively few days the Hymenoptera claimed my whole attention, these being (at least the Aculeata) conspicuous and easily collected, and this also applies to the Odonata. The Neuroptera, Orthoptera, and Hemiptera, as represented in our fauna, are naturally met with in collecting beetles and now and then I spent a day strictly in catching the larger Lepidoptera. To the Mollusca on Molokai and Lanai I paid a good deal of special attention and very special attention to certain species.

As to the modes of collecting the most successful are exactly those which would be employed by a successful collector in any other country, the difference between the islands and most countries being that many situations, which might be expected to produce a good harvest, will be found comparatively barren. Very few species of Coleoptera will be swept from low herbage, even in the finest localities. Sweeping, when employed, should be rather done amongst the branches of trees and shrubs. This is very natural, seeing that nearly all the beetles are attached to, or bred in wood, dead or alive, but chiefly in dead or diseased trees. A good many of the species sun themselves on the foliage of living trees and shrubs, but rarely descend to low plants. Comparatively speaking, very rarely is any beetle seen upon the wing. These remarks of course apply solely to the endemic fauna. Light is very attractive to Lepidoptera, both large and small, and especially in wet localities, no doubt for the reason that in these, dark cloudy nights are most frequent. Clear cold nights are almost useless, and worse still if there is a strong wind. Even the smallest moths will sometimes come freely during very heavy rain, and a black windless night with torrential downpours, which cease at intervals, are the very best, during those intervals. Even the butterflies, *Pyrameis tammeamea* and *P. atalanta* sometimes are not infrequent visitors under such conditions. Flowers are attractive to many moths both by day and night, especially the Ohia (*Metrosiderus*) from which at night some kinds may be shaken to the ground, either unable or unwilling to fly. The usual bait of sugar, tried at various times, in good localities for *Agrotis*, failed to attract anything except the little *Hypenodes*, so similar to the European one, which, as is well known, is itself very freely attracted. Fern-fronds in a certain stage of decay are very attractive to *Agrotis*, and when feeding on these they make no attempt to fly, but fall to the ground, when disturbed. Aculeate Hymenoptera and Odonata do not need looking for, but it needs a practised eye to distinguish the very similar species of the former, so as to be able to pick out the rarities without a wholesale slaughter. Flowers, except a few fleshy kinds that easily decay, are not attractive to beetles, excepting some species of Nitidulidae and the Elaterid genus *Eopenthes*. The minute and obscure Diptera, the endemic species largely consisting of small Dolichopodidae, which shrink and distort on drying, and of infinite numbers of *Drosophilidae*, many of these also becoming distorted, have been little collected.

It is quite certain that only a fraction of the fauna has yet been collected, and that the groups are very unequally known. The small group of native dragon flies may not be greatly added to and the aculeate Hymenoptera are fairly collected, both of these being as one might almost say obtrusively present as a whole, as compared with other insects, of which but few species are both numerous and conspicuous at the same time. On the other hand three hundred species of *Drosophila* would be a moderate estimate of those existing. It is possible that half the number of existing species of insects have been collected, but this is by no means certain.

During the last ten years, since the annexation of the islands, it has gradually become much more easy to get about than was the case during the chief period of my collecting, and many mountain localities have been opened up, which before were impossible for the collector or at least very difficult of access. At the same time the existing forest is being much more strictly preserved from destruction.

I did much of my collecting from a small tent, which, usually, I had packed for me on horse or mule over the lower slopes to the lower edge of the forest and from that point packed it myself with the necessary supplies and collecting apparatus into the heart of the forest. Skinning birds and pinning insects while either sitting on the ground or lying down was at first troublesome, but after a time seemed natural enough. In some very wet forests, where I had to spend much time for the birds, I was obliged to carry a limited supply of oil and a small oil-stove on account of the difficulty or impossibility of making a fire on my arrival at night after a long day's collecting, during the continuous and heavy rains. But such cases were exceptional, and otherwise, after a little practice, it was always possible to build a fire in the open (even in very wet weather) for the purpose of cooking rice,—practically the only cooking that the habitual camper-out need attempt. This with coffee and sugar and one or two kinds of tinned meats (in addition to a tent, clothing and apparatus) will be found as much as the collector will care to pack on his back in so rough a country, and I found the stove and oil a sore burden, very reluctantly assumed. Except for very special purposes I never took a native with me on these camping expeditions, partly because it was almost impossible to get one man to go without companions and partly because the impedimenta would be proportionately increased as the number to be fed and sheltered was added to. In some of these untrodden forests many of the birds (excluding the most wide-ranging species which seem generally to have more or less fear or shyness of man and the little fly-catchers, which are everywhere very tame or inquisitive) were absolutely fearless, and it was only just not possible to touch them with the hand. Sometimes it was quite impossible to shoot a rare species, since it would keep following up the collector, as he moved away, perching overhead at only a gun-length's distance. Then, its curiosity satisfied, it would fly off altogether and be lost in the density of the brush. Excepting in the more open forest, in the neighbourhood of ranches, the woods are quite uninhabited, and sometimes for weeks together I never saw a human being. Occasionally a native would come up and leave letters for me or take them down from my tent, but usually I was away collecting, when he arrived.

Hawaiian islands much richer in species than has been supposed, and the scarcity of individuals of species exaggerated.

Oceanic islands are generally said to produce but few species of native insects, but their unproductiveness has certainly been exaggerated, owing to the hidden life and small size of so many of these inhabitants. It has also been supposed that individuals of the species are as a rule and comparatively speaking rare. In the case of the Hawaiian islands, and probably of most remote oceanic islands, the insects and other animals are limited to a small variety of types compared with other lands, but the types represented are often extremely rich in species, which, one might almost say, do their best to fill up the vacancies caused by the absence of many forms of life almost ubiquitous elsewhere, but which have never reached these remote islands. When talking to the late Dr Ashmead, who visited the islands in 1900, he insisted that certain large groups of parasitic Hymenoptera, of which he had a specialist's knowledge, must, being of universal distribution elsewhere, be really well represented in the islands, though no species (excepting a few evidently imported) had ever been collected. But in reality it is not at all surprising that these do not occur. Firstly the chances of any vagrant insect, carried across the ocean either by wind or wave, happening to land on a few small spots in mid ocean must be very small, and then the possibility of its acclimatisation has to be considered. We know from practical experience that many insects, which it has been desired to introduce, fail to establish themselves in this climate. If a plant-eating species, it may find no fit vegetable food, if parasitic, no fit animal food. But in the case of such specialized creatures, as most parasitic insects, unless either a number of the host, they feed upon, has arrived with them, or previously, and become established, or unless there happens to be some other insect present, which may serve as a new host, the chance of a successful occupation by a parasitic insect is very small.

The paucity of individuals of a species is also, I think, much less than has been supposed, this supposition being due to the small size, hidden life and special habits of many of the creatures. I do not feel sure whether the number of really rare species is greater than is the case elsewhere *over an equal area of land.* On large land areas a species may occur in very small numbers, but persistently, over a limited portion of the area, while in other parts removed from this, it may be continually abundant, and small islands do not afford these conditions. On a continental land if one picks out a continuous area, equal in size to one of our islands, there will be found large numbers of rare insects, even in countries much more collected over than the Hawaiian group. It is natural that a collector in a country of great roughness and with extensive virgin forests, collecting in a limited time not only all kinds of insects, but all other land animals, will obtain many unique specimens and also species represented by only one or two examples, both from lack of time to make special search for each particular species and because many insects even though they have no regular season, become more abundant at one period than another and the best time may be missed in a particular locality. Also in pathless forests, where a species is very local, and particular as to the exact condition of its surroundings, it is often not possible to find again the exact place where it happened to be met with. In restricted localities, that have been often visited and collected over, most of the species have at some time or another been found in some numbers and many in abundance. Again the personal equation comes in. The collector particularly fancies certain species and devotes much time to these, while others he is liable to neglect, in so far that he picks up only a few specimens. For this reason the number of specimens cited as captured, in the systematic portion of this work, should not necessarily be regarded as showing the rarity or otherwise of a species. For instance, the conspicuous dark-coloured, day-flying moth, *Dasyuris holombra*, of which two specimens are recorded, I observed in hundreds, if not thousands, on one occasion, flying in the forest on Maui, but being always hampered with a gun and much occupied with birds, I neglected to catch a series and did not again have the chance. A number of species of beetles, of which I captured long series, are undoubtedly amongst the rarest Hawaiian insects. My experience in this matter is different from Mr Blackburn's, who says "the very common insects" are "few indeed and the rather common ones almost none at all." We should rather say (speaking of course only of the endemic fauna) that the rather common species are numerous, the excessively common ones, less so, though there are a considerable number of these. He also remarks that "It is by no means an unusual thing to pass a morning collecting on the mountains (at any rate on those under 3000 ft. high) and to return home with perhaps two or three specimens secured, and having seen literally nothing else except the few most abundant insects." I am quite sure that this must be due to his having neglected to get beyond the range of the small ant *Pheidole megacephala*, before beginning to collect. A coleopterist of some experience in island work (and perhaps even without this) in the mountains close to Honolulu may take about forty species of beetles in a fair day's work, between 1500 and 2000 ft. elevation, though he has a considerable walk to and from the collecting ground. Almost the last day I collected in that locality, I took exactly that number of beetles (*Cis* 6 species, *Proterhinus* 10, Carabidae 5, Curculionidae 7, Histeridae 1, Cerambycidae 2, Staphylinidae 1, Nitidulidae 7, Anobiidae 1) in addition to numerous other insects, and had it been a different season, stray species of Elateridae would certainly have occurred. I do not doubt I must often have exceeded this number of species, especially as on this occasion I was by no means well and really unfit to attempt collecting in the mountains.

It has been suggested that close interbreeding may result in diminished fertility and in a paucity of individuals of island species, and that such interbreeding is very common there is no doubt. But whether in insects this inbreeding has any such result is extremely doubtful. We can feel quite sure that some of the introduced insects in the islands have originated from one or two, or very few individuals, accidentally imported by man, and of others imported for economic reasons we know this to be the case. Yet though some of the former were introduced at least half a century ago and have produced probably at least several broods a year ever since, and some of the latter complete a generation each month or even more quickly, these all remain as common as ever and show no sign whatever of degeneration or impaired fertility. Of imported insect pests it is sometimes said in a careless manner that these naturally disappear or become insignificant in time from being "played out," but I do not doubt that careful investigation will show that in such cases the real cause of decrease is that they become attacked, after a while, by other insects or diseases, and especially by parasites and predators, which transfer their attack by degrees from native species to the foreign immigrant. Deterioration in insects, supposed to be due to inbreeding, is much more probably due to the ill-effects of the unnatural conditions of captivity. The extreme sluggishness of so many of the insects and Mollusca leading to great restriction of locality, which we observe also in the birds, must lead to extreme inbreeding. We have observed colonies of some of the flightless beetles to persist for years in a single tree and where these colonies are isolated from others, no doubt all the inhabitants have resulted from a few stray examples, probably often from one. While the food remains in suitable condition these isolated colonies thrive and become very numerous, but they are, doubtless, often totally exterminated when it becomes no longer suitable, unless, by chance, individuals can reach some other tree fit to supply a breeding ground. Obviously this sluggishness and restriction of range must itself diminish the numbers of individuals of a species, and the tendency of island creatures to limit their range and to specialize their habits is a striking feature of the fauna. Loss of the powers of flight is a very common phenomenon in this connection.

Number of species of insects and causes of extinction.

The total number of Hawaiian insects known to me at the present time is about 3325, but of these only about 2740 can be considered as belonging to the natural fauna. Owing to man's interference and his introduction of foreign creatures, I should consider that about 300 species have been exterminated, without being collected. Mr Blackburn's and my own collecting, together with some aid received from others, has in my opinion resulted in the collection of about half of the existing species of native insects, so that a perfect collection of this section of the fauna, made before man's interference, might have yielded about 5780 species. I may have somewhat underestimated the number exterminated.

It is known that several species of Passerine birds, formerly abundant, had become either totally or nearly extinct before I came to the islands, twenty years ago, and there is reason to fear that several others may since have disappeared. At any rate, we know certainly that some, which were abundant, have become much less so, and have totally disappeared from localities where they were common enough. In my paper on the birds (Vol. I, p. 393) I have referred to the causes which have brought about this extinction or diminution in numbers. As with the birds, destruction of forest has, doubtless, caused the disappearance of many local insects, but even of greater importance has been the introduction of foreign carnivorous species, especially of the dominant ant, *Pheidole megacephala*. There is no record of the time when this destructive creature was imported, but even during the last twenty years it has occupied some considerable areas previously free from it. It may be said that no native Hawaiian Coleopterous insect can resist this predator, and it is practically useless to attempt to collect where it is well established. Just on the limits of its range one may occasionally meet with a few active beetles, e.g. species of *Plagithmysus*, often with these ants attached to their legs or bodies, but sooner or later they are quite exterminated from such localities. It is quite certain that native beetles and many other insects are absent from the localities occupied by *Pheidole*, solely on account of its presence. In several instances, as the ant has been observed to occupy a new area, this area having been collected over before it was present and yielding many native beetles, the latter have entirely disappeared. In a few low-lying localities, even close to the coast, there are some places, which from excessive dryness and other causes, the *Pheidole* is unable to occupy, at any rate permanently, and yet unfavourable, as these are, for insects of any kind, here only will native Coleoptera be found. On one occasion I came across an instructive instance of the effect of these ants on the native fauna. A more or less open piece of forest at an elevation of 1500 ft. above sea-level, with a large variety of trees scattered in it, appeared at first sight an excellent spot for collecting native insects. A number of native Hymenoptera were seen flying round the foliage, hardy insects which the ants cannot exterminate, though they are often seen attached to them by the mandibles. Every tree trunk was invaded by *Pheidole*, and beating the boughs dislodged them in thousands. Not a single beetle nor any native insect was obtained from these trees. One solitary tree, however, for some reason was quite free from ants. It was a large *Bobea*, with hanging masses of 'Maile' (*Alyxia*) dependent from the boughs. From the dead stems of this were shaken hundreds, if not thousands, of one species of *Proterhinus*, others also being present, as well as the large weevils, *Rhyncogonus*, and other kinds of beetles. I visited this spot on many occasions for the sake of a rare species of wasp, but never obtained a beetle except from this one tree, and a year later it too was occupied by *Pheidole* and barren of native insects. Fortunately *Pheidole* is not universal in its distribution. It can in some localities just attain 4000 ft. in the mountains, under certain climatic conditions. Below twelve or thirteen hundred feet it often occupies most of the islands, excepting some extremely arid localities. Though not so utterly destructive to other insects as to the beetles, yet many of them are destroyed by it, and generally speaking, collecting is very poor, where it abounds. Most of the native species taken in such places are vagrant, like Lepidoptera, and have bred in some adjoining area, either free from this ant, or where it is comparatively sparse. Miles of attractive forest in some parts of the islands are almost devoid of native insects, through its destructiveness. A very few endemic insects seem able to breed in its haunts, even where it is quite abundant, but many of the foreign or imported insects flourish in spite of it. It is not probable that it will spread to any great extent beyond the limits now occupied, for it has long since filled all suitable localities. Here and there the opening up of limited areas of forest may by change of conditions allow it to colonize these, but the great bulk of the forest is now reserved and not likely to be opened up. There is no reason to suppose that the endemic insect fauna will suffer any considerable further diminution, and it may, so far as one can see, remain as it is for ages to come. The chief danger would be in the introduction of some predaceous creature like *Pheidole*, which would be able to occupy the great area of forest land and the country above this, where *Pheidole* does not now exist. As no such insect has been imported in the course of the last century, it is on the whole improbable that it ever will be.

Comparison of 'introduced,' 'immigrant' and 'endemic' insects etc.

In a memoir on the Hawaiian Coleoptera, published in 1885, by Blackburn and Sharp, the beetles are divided into three classes: (1) 'introduced,' i.e. species imported by man, (2) 'immigrant,' i.e. species occurring elsewhere, but which have reached the islands by natural means, (3) 'autochthonous,' i.e. species peculiar to the islands, for which I have used the older and more often employed term, 'endemic.'

Owing to our very incomplete knowledge of the insect fauna of the world, some of the introduced species and also some considered to be immigrant are not yet known outside the islands. The ant *Prenolepis sharpii* for instance, which was imported years ago in boxes of plants by the Commissioner of Agriculture of the islands, and soon became established and very common, was described from descendants of these imported examples.

In judging whether an insect has been introduced by man, when the actual fact of its importation is unknown, I consider the following points.

(1) If solely attached to foreign vegetation or parasitic or preying on imported creatures only, it is certainly 'introduced,' or (less probably) 'immigrant.'

(2) If, being a beetle or Heteropterous bug, it is found within the range of certain foreign predaceous insects, it may in the case of the former be considered certainly and in the case of the latter most probably 'introduced' or possibly 'immigrant.' In explanation of this I may state, that in the case of the truly endemic beetles, without exception, and usually of the Heteroptera, the area of distribution is absolutely fixed by the non-occurrence of imported predators. Owing to interference by man these predators may come to occupy new areas, and then from these too the above-mentioned endemic forms disappear. At first, in such cases, many of the endemic beetles will be found actually being attacked by these enemies, but subsequently they will disappear. Some insects, however, e.g. bees and wasps and some Lepidoptera, more or less successfully resist such predators, and though endemic, can occupy the same area, as also can others that rarely or never are attacked, e.g. certain Homoptera that excrete honey dew.

(3) Doubtfully endemic insects may occur outside the range of foreign predators and mixed with many truly endemic ones, but usually they also range into the territory occupied by the former. If not, their habits should be considered and their food, and the probability of their being imported by man, but if they do so they are most likely 'imported' or 'immigrant,' and surely so if Coleopterous.

(4) Actual affinity to, or remoteness from outside forms must always be considered.

(5) Whether the species is isolated from other members of the fauna, or whether one or more closely allied forms occur is most important. When several closely related species are found in the islands the probability of their being endemic is very great. Importations by man usually consist of very different insects and not of closely allied species, and the same would be likely to be the case with natural immigrants.

A careful consideration of such points in the case of any insect that is fairly well studied, will usually leave little doubt as to whether it is endemic or introduced. It is perhaps more difficult to distinguish the immigrants from either the endemic or the imported species. We must, however, except from this statement a number of species of known migratory powers, well-known species elsewhere, with great powers of flight, and clearly natural immigrants. Excluding these, the number of immigrants is probably very small, for reasons hereafter given.

Whereas the imported species are in most respects of little interest as compared with the immigrant and endemic, in one particular they are of considerable importance, especially such species as have been established in the islands for many years. Household pests, however, and some others, that we know have been imported again and again, are of no interest. It is probable that such introduced species as the Longicorn beetles *Lagocheirus obsoletus* and *Astrimus hirtus* were established from a single importation of these species. They are evidently not frequently carried by man, for until recent years the former had not spread to the other islands and the latter has not, as far as is known, yet reached them. Yet the former is known to have become so plentiful, as to have been an injurious insect in Honolulu forty or fifty years ago, and the latter has been established at least for thirty years. Though for all these years inter-island traffic has been very heavy, and plants continually taken from one island to another, and especially from Honolulu, where these beetles are common, yet the spread of *Lagocheirus* has been slow, and that of *Astrimus* has not, so far as is known, occurred at all, as stated above. It is, therefore, very unlikely that either of these beetles has frequently or even occasionally been brought to the islands from outside countries, seeing that the traffic between these and Honolulu has been, until recently, comparatively very infrequent. I suspect, too, that these beetles are likely to be more abundant with us than in their native countries. Owing to the equability of the climate, on account of which so many insects breed the year round, and often produce many broods in a year, many species have passed through very many generations since their introduction. Some of the imported creatures we know from observation complete their life-cycle in three weeks, and brood follows brood without cessation. Yet, when we examine examples of these species, we may well feel some astonishment at the fact that they quite resemble those found in their original home, even though this differs greatly in climate and otherwise, and they exhibit no particular variability. Some (e.g. certain Coccinellidae) notably variable in their native homes, appear to exhibit even less variation here than in their own country. Looking at the imported species as a whole, we must allow that these show no tendency to special variation, and there is not the least reason to suppose that the variability seen is greater than, or different from that, which they exhibit in their native homes. One is struck with the stability of specific characters, and a study of these imported insects as yet throws no light on the question as to whether variation arises suddenly or by slow degrees in a species. One would infer that much time is as a rule required for the appreciable modification of a stable species.

The immigrant species are of two classes like the introduced ones: (1) those that are, doubtless, more or less frequent immigrants (*Pyrameis cardui*, *Nomophila noctuella*, large dragon flies etc.) and (2) those which are chance immigrants, of which no second immigration would probably take place in ages, if at all. At any period of the history of the islands these chance immigrants must be very few in number, for reasons stated elsewhere, and owing to the obscure nature of the fauna (obscure insects being very imperfectly known in other tropical countries) we cannot be sure whether certain species suspected of being immigrants are really so, as they have not been detected elsewhere, and they may in reality be endemic. This is unfortunate, because they are the potential ancestors of future endemic forms. Thus the Cossonid beetles *Deinocossonus* and *Orothreptes* are possible immigrants and so are such species as *Prays fulvocanellus* in Lepidoptera, but they have not been recorded from other countries. A very few species, e.g. the Tortricid moth, *Bactra straminea*, are almost certainly immigrant. If we examine these supposedly immigrant species and in conjunction with these consider those endemic ones, which are little modified from outside forms, and therefore are to be considered as a development from the more recent immigrants, we find a very different condition from that above noted in the case of introduced species. There may be a few constant species amongst these, and this may be due to the fact that such have been comparatively a short time in the islands and are the most recent natural immigrants, but these are certainly very few. We at once note the large amount of variability exhibited by the species. In this connection we may review a few species, which are either the sole representatives of their genus (and not, or very little, different from the outside forms) or at least have only one or two other species related to them in the islands. In the Aculeate Hymenoptera, the small ant *Ponera perkinsi*, hardly separable from foreign species is the sole native representative of its group. It is widely spread, occurs in many localities from near the coast to above 4000 ft., and exhibits considerable variation. There is sometimes a distinct tendency to specialization in variation in different localities. In the parasitic Hymenoptera, *Echthromorpha maculipennis* varies very greatly and individuals might at first be taken to represent distinct species. The small cockroach *Phyllodromia obtusata* is notably variable, so as almost to have given rise to a distinct species in parts of the island of Molokai. The earwigs listed under the names of *Anisolabis pacifica* and *maritima* in the systematic portion of this work, the former possibly endemic and the latter immigrant, are variable. The forest-frequenting species of *Calotermes*, which I expect will prove to be peculiar to the islands, exhibits notable variation in different localities. *Bactra straminea*, a New Zealand moth, is excessively variable and I consider that some of its local forms will probably prove to be distinct species. Another small moth *Hypenodes altivolans*, some varieties of which differ very little from the widespread *H. costaestrigalis*, is extraordinarily variable. The Pentatomid bug *Oechalia grisea* varies very greatly, and there is at least one offshoot of this, of restricted habitat and forming a distinct species. In birds the native duck, possibly a puny descendant of *Anas boschas*, is so variable that some ornithologists have supposed we have more than one species. In beetles *Pentarthrum prolixum* and the *Parandra* are variable forms. It is of course possible that all these may have been variable on their arrival in the islands, or are the descendants of variable immigrant species, but the variability in this class (i.e. immigrant species or comparatively recent developments from immigrants) is so very general, that this seems improbable, comparing them with the species accidentally introduced by man.

The endemic fauna of the islands consists for the most part of genera containing an inordinate number of species, evidently allied to one another, e.g. *Scotorythra* and *Hyposmochoma* (Lepidoptera), *Proterhinus* (Coleoptera), *Nesoprosopis* (Hymenoptera), *Anomalochrysa* (Neuroptera), *Paratrigonidium* (Orthoptera), *Drosophila* (Diptera), *Achatinella* (Mollusca), and many others. If the genera are weak in species they are generally, if isolated in the fauna, highly peculiar in structure, or they are evidently merely offshoots from some of the larger genera. In the Passerine birds the genera are numerous, but they are mostly weak in species. The large genera of insects and shells often consist of many variable species, though in these large genera some of the species are generally stable. More rarely there are genera, containing many species, few or none of which are conspicuously variable, at any rate not sufficiently so, as to cause any serious difficulty in defining the species. Probably these genera of stable species have reached the furthest point of development possible under the existing conditions in the islands. If we examine the series of allied forms of the Passerine birds, as they exist to-day, we see that a large number of them have reached such a stage of specialization for a certain mode of life, that we can hardly conceive that they could under any circumstances give rise to new forms. These could at most arise from some of the more generalized. Possibly the same is the case in the large genera of insects, of which the species are in a stable condition, though we are unable to appreciate the relationship of structure to habit as easily as we can in the birds.

Distribution of animals by natural agencies.

All the islands being volcanic and having been built up from a great depth of ocean at various periods, their entire fauna naturally originated from immigrants derived from other lands. These immigrants must have arrived either by flight, like the birds, or in drift like the flightless insects and probably the land Mollusca. Some of the flightless insects, however, that we now find in the islands, have no doubt lost their powers of flight after their arrival, or more properly speaking are the descendants of well-winged ancestors, and in this respect are similar to the little flightless rail (*Pennula ecaudata*) now extinct, but others, for instance some of the genera of weevils were, equally certainly, flightless when they arrived. These can only possibly have reached the islands in drift. That insects can pass over enormous distances in floating logs of timber can be seen from the study of the little weevil, *Dryotribus mimeticus*, whose natural home appears to be in drift-wood, and which not only occurs in Florida, but in the Hawaiian group and in Australia. In the case of the Hawaiian fauna many of the winged insects might quite possibly have been transported in this manner, for in their larval stages they live in the wood of dead trees, or beneath or in the bark, or they frequently, even if leaf-eaters as larvae, creep into the cavities of dead branches or beneath the bark to pupate. It is only necessary to look through the various families of insects, the habits of which are recorded hereafter, to see what a great proportion might have been carried in this manner. As is well known the common drift of the islands, derived from outside, consists of coniferous trees from North-West America, but few and probably none of the elements of our fauna can have been derived thence. Our insects have no relationship with those from that quarter, and it is unlikely that such drift would bring insects that would become acclimatized in the islands. Roughly speaking the Hawaiian fauna may be said to have been derived, so far as we can judge from its affinities, from immigrants received from the warmer parts of America, from the Australian and South Polynesian islands, and from the Oriental region. I do not place much importance on the fact that there is certainly no regular deposit of drift wood from any of these regions at present on the island shores, for with our scanty representation of types, it is only necessary that once in thousands of years an immigrant-bearing trunk or log should reach them. Certainly a careful consideration of the components of the Fauna would lead us to believe that this must have happened. Dr Guppy places little importance on drift in his considerations of the origin of the Hawaiian flora and very great importance on the birds; but when I consider how often I have found great numbers of seeds held beneath the dead bark of trees in the mountain forests, I cannot overlook the possibility of original components of the flora having arrived this way, as have those of the fauna. Further when one considers that even in our limited fauna, a single tree trunk may contain a score or more of distinct species, beetles and their larvae in the wood and bark, caterpillars boring the wood or living beneath the bark, well-sealed nests of bees and wasps, often in old beetle borings, with possibly Mollusca adherent to the bark, or beneath it, or wedged in crevices, besides other creatures and perhaps parasites of some of these, we may fairly suppose that once in a long period, some such micro-fauna may have been washed out to sea and stranded on these islands, and that some at least of the emigrants have survived and become established.

Though the distance between the islands and other lands is so great, yet we know that, like the migrant birds of Alaska that regularly visit the islands, certain insects of migratory habits like the large dragonflies, the butterflies, *Pyrameis cardui* and *huntera*, the small moth, *Nomophila noctuella*, and others have been able to reach the islands, and probably still do arrive from time to time, so we need not feel any difficulty in believing that at some period a lesser-sized dragonfly (Agrion) or an ant-lion (*Formicaleo*)—insects which could only have arrived on their wings—have been able to traverse a similar expanse of ocean by some rare chance. In many cases the winged insects may not have arrived this way, because in their earlier stages they could well have been carried like the flightless beetles and wingless animals. Over what distance minute and delicate winged insects can be wind-borne is not known, but probably under favourable circumstances it is very great. Some small moths, as reported by Muir and Kershaw, are able to rest on the sea and again take wing, but such cases are probably rare, and I imagine this faculty would not be of much aid in traversing such great distances as we require. High and steady currents of air are probably most efficient. A number of the existing species of moths are of powerful flight and are partial to wind-swept country, and it is a familiar sight to see these, when disturbed, allow themselves to be carried far away on the strong wind. Given this habit of allowing themselves to be thus carried, small moths might even be able to pass over greater distances than heavier-bodied species. In the interisland distribution of species whirlwinds may have occasionally assisted. These are most frequently observed on the plains, and I have recorded how even so strong a bird as the imported *Acridotheres* may be carried up many yards before it can extricate itself. These whirlwinds have been seen to carry up thick columns of dust to an elevation of over 2000 ft., and we have once or twice observed them to originate at this elevation in the mountains. Small creatures carried up in this way and meeting high currents of air might be borne for great distances before alighting.

Flightlessness in Hawaiian insects.

Amongst the Hawaiian insects there is a very large number of species in which either one or both pairs of wings are so reduced as to be useless for purposes of flight, or the hindwings may be entirely wanting. These cases in which we may suppose the loss of the powers of flight to have originated within the islands themselves are of considerable interest, and we may briefly review the insect fauna from this point of view.

In Lepidoptera one case of flightlessness only has been so far observed, that of the large Gelechiid moth, *Hodegia apatela*, the female of which has all the wings so reduced as to be quite useless for flight. The male is not known, but it is very probably fully-winged. This genus is merely an offshoot of the endemic fully-winged and dominant genus *Thyrcopa*.

In Diptera, flightless forms are, so far as is known, confined to the Dolichopodidae, several species (probably of two genera) having these organs reduced to mere filaments. One of these, *Emperoptera*, is an active and brightly metallic little fly, living on the ground beneath forest trees; the others are, I believe, sluggish, and live in very wet moss, clothing tree-trunks in dense wet forests. These are, I suspect, derivations of the genus *Campsicnemus*, and are undescribed.

In the Hymenoptera, apterous forms are mostly such as are found in other countries, but the flightless Diapriidae were probably derived from allied fully-winged forms such as still occur with them. In the flightless species intermediate conditions of the abortion of the organs of flight are known.

In the endemic Heteropterous bugs, one species of *Metrarga* has become apterous, and a large section of the genus *Reduviolus* (Nabidae) is quite flightless, as are the terrestrial members of the family Emesiidae. The species of *Acanthia* have the wings, so far as is known, always so reduced as to be useless for flight. In the Homopterous bugs many or most of the endemic Delphacidae appear to be always flightless, and if winged forms are produced at all, it must be at very rare intervals. Some, however, are always fully winged, so far as is known.

The Neuroptera contain the remarkable endemic genera of Hemerobiidae *Pseudopsectra* and *Nesothauma*, both flightless, the former with minute hindwings and the front pair not greatly modified, while the latter has these hardened and sculptured, so as to resemble more nearly the elytra of beetles. These genera appear to be derivatives of the more ordinary *Nesomicromus*, a dominant genus in the islands.

In the Orthoptera, the Locustid genus *Banza* (*Brachymetopa*) are all flightless, while in the Gryllids all the little crickets of the genus *Paratrigonidium* are wingless, and flying individuals are never developed as dimorphic forms, in the way that we have observed in some Trigonididae of other countries. All the prognathous crickets (*Prognathogryllus* and allies) are flightless, but the wings are so far developed in some forms as to suggest that their present condition has been reached in the islands, while others are without rudiments of wings and almost without tegmina.

Turning to the Coleoptera, in the Curculionidae, the genera *Oodemas*, *Heteramphus*, etc., containing only wingless forms, are so isolated in structure that one cannot tell whether their winglessness has originated in the islands or whether the forms, from which they were derived, were wingless when they originally reached the islands, but the latter may have been the case, as with *Rhyncogonus*, the foreign species of which are also wingless. The extensive genus *Proterhinus* consists of wingless forms, whereas the foreign *Aglycyderes* is winged. Unfortunately I did not examine the unique example of Samoan *Proterhinus*, which possibly is a winged form, and the specimen is not at present accessible to me.

Of the Cioidae many species are flightless and some of these have a remarkable superficial form, and have been segregated under a new generic name, *Apterocis*, but other species, still left in the genus *Cis*, are also flightless, and the wings appear to be in different conditions of degeneration, though in most of the species they are fully developed. It is not quite certain whether winged and flightless forms may not occur even in the same species in one instance.

In the Elateridae of the subfamily Eucneminae, an uncertain number of the species of *Dromacolus* are flightless, while many of the genus are fully winged and are occasionally taken in the act of flying. Of the true Elateridae Dr Sharp believes that one form, *Dacnitus currax*, is flightless. It is allied to the endemic genus *Itodacnus*, which flies freely.

The single Lucanid genus *Apterocyclus*, somewhat allied to *Dorcus*, is flightless and endemic.

The Nitidulidae are mostly fully winged, but four genera, containing in all nine species, are flightless, while the remaining 129 species in nine genera are fully endowed with flight. The amount of degradation of the wings in the flightless forms varies according to the genus or species.

The endemic Histeridae of the genus *Acritus* have flightless species, but these are probably much less numerous than the fully-winged ones.

In the Staphylinidae some of the species of *Myllaena* are apterous, their congeners being fully winged.

Of the endemic Carabidae 184 are flightless, the fully-winged species only 20. Nearly all the flightless endemic insects are inhabitants of the forest, or if they frequent exposed situations like some of the Carabidae, they are closely related to species that frequent thick forests and are equally flightless. There is no ground for supposing that in these islands, as has been suggested for flightless insects inhabiting other Oceanic islands, the wings have been lost or degenerated through the agency of natural selection, as being a source of danger, if used on small land areas, where flying insects are supposed to be liable to destruction from being blown out to sea. Only in the case of the moth, *Hodegia apatela*, could this theory be applied by any stress of imagination. So far, *Hodegia* is at present only known from open and wind-swept localities, and it inhabits these both above and below the forest region. Practically it is a flightless species of *Thyrcopa*, and fully-winged examples of this genus have been observed to flourish in the most wind-swept of all regions close to the sea margin. Still more delicate Microlepidoptera are found in similar open country, and many of these as well as the fully-winged species of *Thyrcopa* seem to be far more successful than the *Hodegia*.

All the cases of flightlessness in Hawaiian insects are, I believe, to be explained simply by 'disuse.'

If we consider the case of the endemic Heteropterous bugs, we find that all the flightless forms are either entirely or to a great extent of terrestrial habits. The winged species of *Metrarga* though they may descend to the ground, yet habitually breed on certain plants, often at a height from the ground, but the terrestrial *M. villosa* is flightless. All the truly arboreal Reduvioli are winged and are sometimes seen on the wing. Some may overlap with the flightless forms in their habitat, but on the whole the two groups are quite distinct. The apterous Emesiidae are also terrestrial. The Elaterid, *Dacnitus*, is terrestrial, as is the Lucanid, *Apterocyclus*. Many of the flightless insects are conspicuous for their sluggishness, e.g. the subapterous Nitidulidae, and amongst these we find the only terrestrial species of this family. Many of the Carabidae that are flightless are arboreal in their habits, but these are all able to run quickly, and many of them are extraordinarily active. It must be remembered that in creatures inhabiting a dense forest belt, as most Hawaiian insects do, many of these, when in search of new feeding grounds, at most require to descend from one tree and ascend another. Predaceous creatures like Carabidae and many of the feeders on dead wood, as we have often observed, infest the same tree year after year, and probably only cease to do so as the tree itself fails to afford suitable food for the creatures that it supports, both those that feed on its substance and those which prey on these. Doubtless with very sluggish, flightless beetles the death of a tree often entails the death of numerous individuals, but during its occupation by generation after generation, individuals may become dispersed and colonize adjoining trees. In the case of more active forms like the Carabidae, the death of a tree, that is their home, need cause no loss of life of the beetles. It is instructive to note that in the case of beetles, which require for their food that a tree should be in a special state of disease or decay, lasting only for a short period, e.g. the bark-eating Longicorn beetles, and the burrowing Scolytidae, no case of loss of flight is known to occur. That many creatures, which find an inexhaustible food supply within a very small area, should become more and more sluggish or loth to fly, and finally by disuse lose their powers of flight, seems quite natural. Natural selection may have prevented the loss of flight organs in some of the island creatures, but it has probably had nothing to do with the degeneration of the wings in the flightless ones. Had any of the Plagithmysine Longicorns or the Passerine birds taken to a terrestrial life, we should probably find flightless examples of these, as we do in the Nitidulid beetles and in the (now extinct) small rails of the genus *Pennula*. On the other hand sluggish Nitidulid beetles that affect flowers are never flightless for obvious reasons.

Except in one or two isolated and doubtful cases (*Cis* and *Bembidium*) there are no instances known in the endemic Coleoptera or Heteropterous bugs, where a species has both fully-winged and flightless individuals. In fact the only case known where, apart from the condition of the wings, individual beetles are apparently inseparable, is that of *Bembidium molokaiense* (winged) and *Nesocidium lacticulum* (flightless). In the Homopterous bugs, however, we have fully-winged and flightless forms of some species, e.g. of *Aloha ipomoeae* and *Nesosydne ipomoeicola*, of which fully-winged forms are only produced at times and are then less numerous than the brachypterous. These species both occur outside the forest. Of those found only in the forest on ferns or trees I know no such cases of dimorphism, so, if any exist, they must be rare. Many species are only known as fully-winged forms, e.g. the several species of *Aloha* that feed on the Myrtaceous tree *Metrosiderus*. Most of the species of the extensive genus *Nesosydne* are flightless, but *N. koae* appears to be always fully winged. This latter, though it feeds on a common and gregarious tree (*Acacia koa*), yet appears to have peculiar habits, so that few Koa trees, as a rule, are in a condition to support it, since they bear no true leaves. Whether this fact concerns the retention of the organs of flight is worthy of investigation. In fact a careful study of the winged and wingless forest-frequenting species of *Nesosydne* would be of considerable interest.

Probable origin of the existing fauna from very few immigrants, the large genera, or group of allied genera originating from a single or few ancient immigrants. Comparison with the Flora.

When we look at the Hawaiian fauna as a whole we cannot help remarking the numerous genera, which comprise an inordinate number of species. Also, we note that a tribe or subdivision of a family will be represented by a number of closely allied genera, these together including many species. Or, as in the Drepanidid birds, a family may contain many closely allied genera, though these have but few species. A few characteristic examples may be cited. In insects, of the Lepidoptera, *Scotorythra* (Selidosemidae) has more than thirty species; *Scoparia* (Pyraustidae) about 60; *Thyrcopa* (Gelechiidae) about 30; *Aphthonetus* and *Neelysia* (Hyponomeutidae) each about as many as the preceding, and *Hyposmochoma* of the same family about 180; *Heterocrossa* (Carposinidae) contains more than 30 species. Of many of these, species still undescribed are also known. In Coleoptera, *Oodemas* (Cossonidae) has 46 species; *Proterhinus* (Proterhinidae) no less than 136; while the Cerambycid genus *Plagithmysus* has 33; *Xyletobius* and *Mirosternus* (Anobiidae) have 52 and 70 species. In the Odonata or dragonflies, *Agrion* has two dozen species, and the Neuropterous *Anomalochrysa* (Hemerobiidae) thirty. The genera *Nysius* and *Reduviolus* in Hemiptera, together with about 50 species, form nearly 40 per cent. of the endemic Heteroptera, while the Homopterous *Nesophrosyne* has a multitude of forms, 42 having been described. In Hymenoptera, *Odynerus* (Eumenidae) has nearly 100 species, and *Nesoprosopis* (Prosopidae) more than 50.

The Molluscan genus *Achatinella* contains 107 species, as enumerated by Sykes, *Amastra* 101, and *Leptachatina* 75. Even allowing that many of the described species may prove to be only varieties of others, the genera are of very large extent.

With regard to series of genera that are closely allied to one another, it will be noticed that many of the genera already named as containing a great number of species, have themselves given rise to offshoots of generic value, i.e. have produced species judged to be more different from the aggregate of species they contain, than are these one from another. In the Carabidae, the Anchomenini contain 17 genera more or less closely allied to one another, and the Pterostichini four, the latter tribe with 76 species, the former with 106. The Plagithmysini of the Cerambycidae contain three closely allied genera, and the Prognathogrylline crickets (Gryllidae) four.

It becomes of importance to consider whether these great series of congeneric species and smaller series of allied genera have been developed in the islands from a single anciently immigrant ancestor in each case, or have sprung from diverse ancient immigrations. Are we to consider that Drepanid birds, Anchomenine beetles, moths of the genus *Hyposmocoma* and *Scotorythra*, etc. etc., have more or less frequently safely reached the islands in past times and become established? If this be the case the successful immigration of outside animals must have been of comparatively common occurrence. If we are able to say in any instance that in the case of one of these series, whether of genera or species, that one species or genus is more closely allied to some foreign form while another is more closely allied to a second foreign form, than are the Hawaiian species or genera to one another, we should naturally suppose these to be of different origin. Thus the moths of the genus *Margaronia* are very different, and clearly belong to quite different groups existing outside the islands, and cannot be supposed to have developed within these from a common immigrant ancestor. One in fact (*M. exaula*) differs very slightly from foreign species, and the fact that its caterpillars are sometimes found feeding on imported shrubs growing in gardens in Honolulu renders the endemicity of the species very doubtful. It is probably an importation by man and will be found elsewhere.

In a few cases, however, we can, from a study of the structures of the truly native insects and a comparison with outside forms, be sure that the existing species are not sprung from a single ancient immigrant species. This is the case with the great series of Hawaiian wasps of the genus *Odynerus*, one group of which (*O. nigripennis* and its allies) is closely related to Oriental species, and entirely different from the other members of the genus. I suspect that the endemic moths of the genus *Agrotis* are similarly of diverse origin. If we consider the habits and distribution of these genera, that both are dominant forms, almost cosmopolitan, that in almost every country species of each of them are excessively numerous in individuals, we shall not be surprised that individuals of more than one species of each have at different times reached the islands. Moreover, it should be said that neither *Odynerus* nor *Agrotis* (s.l.) are the equivalents of ordinary genera, but comprise a heterogeneous mass of forms, which either remain unclassified or at least are imperfectly understood as to their relationships.

Many of the genera that contain a very long series of endemic species are themselves peculiar to the islands, many in fact are so highly endemic that their relationship to outside forms is by no means close, or even so remote as to be involved in doubt. The time that has been necessary for the isolation of such remarkable genera may well be considered sufficient for the production of the long series of allied species that they contain, without the supposition of several or numerous immigrant species. In compact, smaller groups like the longicorn beetles of the tribe Plagithmysini, the probability of the origin of the Hawaiian series from a single form is, I think, not likely to be disputed by those who have studied the creatures. There are three genera, and the differences between the extreme species is great. Supposing the existing species to have arisen from diverse immigrant species, it would be natural to suppose that one immigrant at least represented each of the three genera. When, however, we look into the differences between these genera, we find that though the bulk of the species are easily enough placed, each in its proper genus, yet some species, forming distinct connecting links between the genera, are still existing. Thus of *Plagithmysus immundus* Dr Sharp remarks: "It is a connecting link between *Clytarlus* and *Plagithmysus*," while *Callithmysus cristatus*, once referred to *Plagithmysus*, shows evident relationship to some species of the latter and also to *Clytarlus*.

It is when we come to examine the more complex groups of allied genera such as occur in the Carabidae or the Drepanid birds, that there is greater room for diversity of opinion as to the multiple or single origin of the Hawaiian forms, as they exist at present. As to the Drepanididae, their case has already been considered in the part of this work dealing specially with the birds. It is of some importance on account of the fact that these birds may by some botanists, who consider the flora to have largely been established through the agency of these creatures, be considered responsible for the introduction of a not inconsiderable portion of the existing plants. If, however, the existing forms have all sprung from a single or dual chance immigration in long past ages, the part that this dominant group of land-birds can have played in the establishment of a flora will be necessarily very small, or possibly of no account at all.

It may be worth while to consider some points in connection with the two important and quite distinct groups of endemic Carabidae, the Anchomenini and Pterostichini. The 17 genera of the former group have been divided by Dr Sharp into two divisions, one with ten, the other containing seven genera. The character separating these divisions is derived from the structure of the tarsi, which in the one case have a peculiar grooved structure, while in the other they are simple. Amongst the genera with grooved tarsi, however, there exist species in which the sculpture is very much reduced or indistinct, and in the genus *Colpocaccus*, some of the species have the grooves much more developed than others. In *Metromenus*, one of the species (*M. politus*) not only has the grooving of the tarsi very obscure, although it belongs to a genus in which this sculpture is comparatively strongly developed generally, but in other respects it bears considerable resemblance to members of the division with unsculptured tarsi. The characters on which the individual genera are separated in these two divisions of Hawaiian Anchomenini are chiefly (1) the condition of the wings, whether rudimentary or well-developed, (2) the absence or presence of sensory setae on the pronotum. In wing-development and in the setae the Hawaiian series are, as a whole, remarkably deficient as compared with foreign forms. Three of the 10 genera in the division characterized by simple tarsi are fully winged and can fly, six have the wings quite rudimentary, but in one of these, *Barypristus*, the one species (*incendiarius*) has wings about twice the size of the other (*rupicola*), while one genus, *Chalcomenus*, has large wings, only the apical portion being somewhat reduced. It is, however, flightless, and no doubt represents an early stage in wing-degeneration. In the other division one only (*Colpocaccus*) of the seven genera possesses functional wings, the others having these organs quite rudimentary. The prothoracic chaetotaxy appears to be in a more unstable condition than was supposed to be the case at the time this character was utilized for generic distinction. Thus *Barypristus incendiarius* is now known quite commonly to be devoid of any pronotal setae, or to have a seta developed on one side only. *Apteromesus maculatus* has sometimes a seta near the hind angles of the pronotum. *Mesothriscus vagans* rarely develops a weak seta at the posterior angles, so that certain examples might on this character be placed with the Hawaiian *Platynus*. One example of a small batch of the very distinct *Metromenus fossipennis* was found to bear a well-developed seta on each side-margin of the pronotum near the middle, so as to become a *Mesothriscus*. It is now known from the examination of individuals taken in company, that some of the Pterostichine species also vary in the setae, so that individuals of one would on this character be placed in two genera. Apart from the variability in the chaetotaxy, it certainly appears to me that the use of this character for generic separation tends to place in different genera species[1] that are really closely allied. Excepting the *Barypristus* mentioned above and a few of the Pterostichine Carabidae, it is proper to state that variation from the normal number of setae is rare and exceptional.

The occurrence of endemic Hawaiian species referred to a foreign genus, *Platynus*, needs special notice. The two known species of this genus (apart from chaetotaxy) are not closely allied to one another, but each much more closely resembles species placed in other Hawaiian genera. If they truly belong to *Platynus*, then it would be necessary, if we maintain the view that the Hawaiian Anchomenini have been derived from a single immigrant form, either to consider this genus (since it is the only one known outside the islands) as having given rise to the other endemic forms, or to suppose that *Platynus* has arisen independently in the Hawaiian group. The Hawaiian *Platynus* is not central in the series of Hawaiian genera, this position being held by such forms as *Colpocaccus* and *Mysticomenus*, both of which it may be noted are fully-winged forms. It should have been noted above that these fully-winged forms are very poor performers on the wing. I think it probable that the Hawaiian Platyni will ultimately be found to be more closely allied to other of the endemic Anchomenini, than to foreign Platynus, and will be separated from the latter.

[1] Some of these species are not only extremely similar in structure apart from the chaetotaxy, but have peculiar and identical habits.

It must be confessed that the extreme forms of Hawaiian Anchomenini are very unlike one another, yet no single genus (as in the case of the birds of the family Drepanididae) appears to be very isolated from its nearest ally. Probably each is more nearly related to its neighbour than to any outside form, and this seems to me in favour of the whole series having been evolved from a single form, anciently immigrant. In any case the possibility of the series having originated from numerous Anchomenine immigrants at various periods of time, each of these immigrants having been such as to fit naturally into the existing series, or at least having given origin to forms that do so fit in, seems very improbable. Should one even propose two ancestral immigrant forms, one most like *Colpocaccus* or *Mysticomenus* (central in the existing series), a fully-winged insect giving rise to the series of genera with simple tarsi, and now mostly flightless, the other perhaps flightless and akin to *Platynus*, giving origin to the series with grooved tarsi and at the same time all flightless, the great resemblance between *Colpocaccus* and *Mysticomenus*, the one with grooved, the other with simple tarsi, and the specific differences in the development of the grooves of the former, may cause him to hesitate to admit even a dual origin for the whole series.

The case of the Hawaiian Pterostichini is much simpler than that of the Anchomenini. There are only four genera, intimately allied, and separated solely by the characters of the pronotal setae. Several of the species are now known to be almost certainly inconstant in these characters, since individuals, not otherwise different, have been found in company (in a 'batch') both with and without certain of these setae. Consequently individuals of one species fall into two genera on the pronotal chaetotaxy. As in the Anchomenini, there is a great diversity of appearance in the members of this group, and here again the setal characters appear to sunder species that are really allied. The large series of existing species do not seem to have required more than a single immigrant species for their evolution. The less diversity of structure as compared with the Anchomenini, I judge to be due merely to the fact that sufficient time has not elapsed for its production. Whereas the Anchomenine Carabidae are now spread over all the islands, the Pterostichines, whose head-quarters are clearly on the central islands (Maui and Molokai) where probably they first became established, are at present not known at all on Kauai (admirably adapted as is that island for their occupation), and even on Oahu are sparsely represented by a few more or less commonplace forms. Looking at the most remarkable of the existing Pterostichines in the islands, it does not require a great stretch of the imagination to see in these the progenitors of future genera as distinct from the more commonplace forms, as are the more remarkable Anchomenini, the genus *Blackburnia*, for example, from the more commonplace Anchomenines. The Hawaiian Pterostichines, speaking generally, are in a wide sense hardly more than flightless forms of *Cyclothorax*, a genus of a few species in the Australian region, a fact in itself opposed to the probability of their having arisen from various immigrant species.

A comparative study of many groups of animals represented in the islands, and of the affinities of species to species, and genus to genus, in the groups of allied forms, has led me to believe in the extreme rarity of a successful immigration from outside. The extraordinary gaps in the fauna of whole families of wide distribution and containing countless species, many of which no doubt would, and some of which, after introduction by man, are known to thrive in the islands, show clearly how hardly and rarely have immigrants reached them from without. A limited number of birds and insects, species of well-known migratory habits, for which no seas are impassable, doubtless, arrive continually, but these, only in the event of such migration ceasing, are likely to produce new and endemic forms.

The phenomena exhibited by the Flora, appear to me to be extremely similar to those of the Fauna. There may be seen the same notable absences of forms widely distributed elsewhere, the same multiplication of allied species of many of the genera that are present, the same groups of allied genera embracing many species. I believe that the explanation of these facts is quite in accordance with that which I think to be true of the Fauna, as above stated. Dr H. B. Guppy, who has paid much attention to the flora of the Pacific islands and the dispersal of plants, as I understand his book, takes a different view of these allied genera and species, and would consider them the result of numerous immigrants.

He considers that there existed an ancient age of Conifers in the Pacific, thereby accounting for the three genera *Dammara*, *Dacrydium* and *Podocarpus* in the Western islands. These three genera are entirely absent from Tahiti and the neighbouring islands, and from the Hawaiian group, the explanation being that at the time these conifers reached the islands of the Western Pacific, the Hawaiian and Society groups did not exist. Later, he tells us, there was an age of Compositae and arborescent Lobeliaceae, during which nine endemic genera of the former reached the Hawaiian group, and one other (Fitchia) became established in Tahiti. There is no trace of this era of Compositae in the Western groups (Fiji, Samoa) owing to the submergence of the Western islands during Tertiary times, the supposition being that during the time, when Hawaii and Tahiti were receiving their Compositae from America, the Western islands existed above water at most as small islets formed by their highest mountain peaks.

Two of the coniferous plants are said to possess seeds that could be carried across wide oceans by the aid of birds, even to the Hawaiian group, and yet during the whole period between the time when the Hawaiian group and Tahiti came into existence, and the present, it does not appear that these have even reached the Samoan group, so comparatively near to Fiji. One would rather suppose that the presence of the conifers in Fiji, like its Cicindelid beetles and some other animals, is due to the continental character of the group.

As to the era of Compositae in the Pacific, the presence of these in the Hawaiian islands and their absence from the western groups does not seem to require the geological explanation above mentioned. The fact of a few species of Compositae having reached Hawaii in early times would account for what we now see. The Hawaiian Compositae are admittedly of American origin and it is natural that the Hawaiian group and Tahiti, being nearest to the American continent, should have received thence immigrants which much more distant groups of islands have not received. Nor need we suppose that there has been any 'suspension' of the means of dispersal of Compositae to Hawaii since, subsequent to the first few earliest immigrants, it must have received the progenitors of *Tetramalopium*, *Lipochaeta* and *Campylotheca*, and probably much later still, *Artemisia*.

Of the age of arborescent Lobelias and their absence from the western groups, the explanation is similar to that given to account for the Compositae. They also are said to be of American origin, and the island groups in which they occur are just those which are nearest to the American continent. We may note that the Galapagos Islands, less distant from the South American coast, also have their own endemic Compositae. Birds which are supposed to have been efficient in stocking the islands with plants, still annually migrate in numbers (of many species) from the American coast.

It may be advisable to consider further and in some detail the endemic Hawaiian Compositae and Lobeliaceae, it being interesting to compare the facts in connection with them with those that concern various elements of the fauna. It should be understood that the Hawaiian Compositae as a whole (endemic and foreign) are to be compared, not with a compact tribe such as the Anchomenine Carabidae, above mentioned, but rather with the Hawaiian Carabidae as a whole.

The four genera *Remya*, *Wilkesia*, *Argyroxiphium* and *Hesperomannia* are supposed by botanists to be extremely ancient forms in the flora, and, on account of their having only two[1] species each, to be in a decadent stage and becoming extinct. Their antiquity as elements of the Hawaiian flora is, I suppose, mainly based on their structural isolation, as compared with foreign forms, but it is said to be also shown by the paucity of the existing species and their restricted range in the islands. Although a limited number of species in an endemic genus is sometimes found, where we suspect that genus to be an ancient component of the flora or fauna, yet more often the oldest elements of the flora are certainly those genera (or groups of allied genera) with the most numerous species and the widest distribution, as is also the case in the fauna. Therefore the primary consideration must be the structural peculiarity of the plants themselves. But we must not altogether overlook the possibility of the discovery of forms in America, more closely allied to these isolated Hawaiian species than those yet known. Besides these supposedly ancient genera, we have *Raillardia* and *Dubantia*, together comprising about a score of species, the genera being related to one another and also allied to the genus *Raillardella* of the Sierra Nevada. Consequently these genera and their species may well be supposed to have originated from an anciently

[1] According to Hillebrand's Flora of the Hawaiian Islands.

introduced form, allied to *Raillardella*, if not actually of that genus. These Composites are common and generally distributed, though *Dubantia* apparently is not known on Hawaii, except from the most ancient part of that island, that part in fact which originally formed the whole island

Next come the three genera *Tetramalopium*, *Lipochaeta* and *Campylotheca* only "on the borderland of generic distinctness," the two former reputed to have species existing in California and Mexico, and the latter practically equivalent to *Coreopsis*. Finally we have *Artemisia* with two endemic species, each occupying a very different station.

The era of arborescent Lobelias is supposed to exhibit much the same phenomena as the Compositae. Dr Guppy says that some are in their prime, others on the point of extinction, and that the distribution of genera and species within the islands shows that the original immigrants were not contemporaneous. They are only found in the Eastern Pacific Islands, chiefly in Hawaii, with a few species in Eastern Polynesia. They are absent from the Western Pacific Islands for the same reasons, it is said, as are the Compositae.

However, on an examination of the Hawaiian endemic Lobelias, we find that there are five genera, all well represented with from half-a-dozen to about thirty described species, excepting the monotypic *Brighamia*, of peculiar habits and occupying stations impossible for most of the others to thrive or even exist in. But there is this great difference between the endemic Hawaiian Composites and the tree-lobelias; of the latter the genera are not only *all* endemic, but they are remarkably peculiar, so much so that Hillebrand did not even hint at their affinities. The seven endemic genera of Hawaii and Tahiti are placed by Engler "in a group by themselves"... "and he does not approve of the endeavours of some botanists to isolate one of them from the rest and to connect it (*Brighamia*) with the Australian *Isotoma*" (Guppy).

Now it seems much more natural to suppose that these allied genera of Hawaiian Lobelias have been developed in the islands from some very anciently immigrant species, than that all the genera (or their ancestors) were originally produced elsewhere and have all become extinct in their original homes. Or if they have become in the islands so greatly modified that their American ancestors can no longer be recognized, the time sufficient to produce such modification would have been also ample to have allowed the development of the large number of species (many being still undescribed) and of most of the genera, even from a single anciently introduced form. One may judge of the near relationship of these Hawaiian genera, when one studies the synonymy of the species and notes how competent systematic botanists have constantly referred identical species to different genera!

While the endemic Compositae may aptly be compared with the endemic Carabidae in the beetles, the Lobeliaceae are comparable rather with the Prognathogrylline crickets, though the evolution of species in the latter has been much less profuse.

Although endemicity of plant or insect, as represented by great peculiarity of structure and usually by the occurrence of numbers of allied species, naturally indicates a very ancient occupation of the islands by their immigrant ancestors, yet it does not necessarily follow that paucity of species or the apodemicity of a genus denotes a comparatively recent immigration. A classification of the Flora, as belonging to a definite age or era, based on such a supposition will certainly prove erroneous. It is not probable that all immigrants, that arrive and become established, are able, even after vast time, to become adapted to such diverse conditions as others, and some, doubtless, are much more slow to do so than others. The evolution of new genera or species would proceed in a very different manner in different cases. In judging the length of time that any particular plant or group of allied plants has existed in the islands, the botanist would be well advised to consider the fauna that is specially attached to these. When one considers that trees little modified from foreign species, e.g. *Acacia koa* or *Sophora chrysophylla*, possess a great endemic fauna, not only species, but even genera of birds and insects, quite restricted to or dependent on them, and that some of these creatures are certainly themselves not less remarkable in their peculiarities than the most peculiar of the Composites or Lobelias, we may hesitate to attribute such plants to a later era than many other elements of the flora, which at first sight appear far more ancient. Again, while in the islands an abundant endemic fauna restricted to a plant indicates an ancient occupation by the latter, the absence of such a fauna does not necessarily imply the reverse. In a fauna of comparatively few types it may happen that few or no species have reached the islands that could become adapted to certain elements of the flora even after great length of time. I think that those who are in favour of the comparatively frequent accession of immigrants to account for the great series of allied species, or groups of allied genera, hardly make full allowance for the great age of the islands. Hitchcock remarks in writing of the most recent portion of the group, the still active Mauna Loa on Hawaii, "when one considers how little the bulk of the mountain is made up of the few flows delineated on the map, and how small a portion of the whole mass these can be, he is overwhelmed by the certainty that there were millions of streams and that millions of years must be assumed in order to say how old the mountain is. It must have commenced to build up long before the tertiary period." And here he is considering the most recent portion of the group and not the vastly more ancient parts.

For my part, as I understand it, the present Hawaiian fauna is derived from waifs and strays from all directions. At rare intervals from the Eocene till now chance immigrants have arrived. Some have been able to establish themselves, many more probably, even after a landing has been effected, have failed. Those that have been successful and have found congenial conditions have often thriven amazingly, giving rise to hosts of descendant species, as they have become adapted to, or become modified by, diverse conditions. There has been no 'age of Conifers' any more than an age of Cicindelidae (of which also a few are found in Fiji), no age of Composites or tree-lobelias any more than an age of Drepanididae (birds) or Plagithmysides (beetles). Where conditions have proved favourable and remained so, and plant or animal has become adapted to special conditions, an exuberance of distinct forms has sprung from the ancient immigrant. Such cases are manifest in the Lobeliaceae amongst plants, and in many groups of animals, the Drepanididae (birds), Plagithmysidae (insects), Achatinellidae (mollusca) and many others. Such form the chief and most interesting part of the native fauna and flora of the present day.

Species-formation in the Hawaiian animals.

As evidenced by the long series of closely allied endemic species of many kinds of animals, it is clear that species-formation has been very active within the limited area of the islands and there is no reason to doubt that this activity still continues. Some insight into the possible modes by which this multiplication of species has taken place may be gained by a consideration of the existing fauna. But what is now needed is not so much general, or even special collecting of existing forms, as years of experimental work in breeding a well-selected series of animals in the field. Unfortunately this cannot be done by residents in the settlements on the coast, but needs a prolonged and continuous residence in the mountain forests. In few cases can the mountain creatures be acclimatized to breed successfully in the lowlands, and it would be folly to embark on a laborious series of experiments, destined to fail, as soon as results were becoming interesting, if not sooner.

Geographical segregation we may judge to have been a most important factor in the evolution of species within the islands. It is obvious that the magnitude of the total number of species of animals is to a large extent due to the fact that, instead of one continuous land area, there are six forest-clad islands, and that in many very large genera very few identical species are found on more than one, and many others in only two or three of these islands. Thus the bird genus *Oreomyza* (Pls. XIII and XIV) has a distinct species on each island. These birds have mostly very similar habits and feed on similar food, in fact it is known that on some of the different islands a good deal of this food consists actually of the very same species of insects. Having a very varied dietary on each island, we may consider that the food of each species is practically the same. Moreover, as some of the species thrive in different areas, each on its own particular island, these areas having quite different climates, vegetation, rainfall etc., it is clear that it is not these conditions that necessarily affect the species. This is a very important point to remember in considering the effects of isolation.

Again and again in insects we find a species inhabiting one island replaced on several of the others by closely allied forms, so that we can feel sure these have been derived one from another or at least from forms hardly different from either (Pl. XVI, figs. 8, 9 and 10). It might be supposed that the small distance between the islands would not be sufficient for isolation, especially when we consider that the animals, from which all the fauna is derived, must necessarily have traversed the vast distances between the islands and other lands. This, however, is clearly not the case. Certain species, of migratory instinct, amongst the birds visit the islands regularly, but do not settle down and give rise to endemic forms, and the insects of known migratory habits, like the butterflies *Pyrameis cardui* and *Anosia crippus*, the foreign species of *Plusia*, *Sphinx convolvuli*, *Nomophila noctuella*, the large American dragonflies etc. we may well suppose receive recruits sufficiently frequently from other lands to prevent any true isolation. It is what we may fairly call the 'chance' immigrant that is the potential producer of new species. It seems incredible that so strong-winged a butterfly as *Pyrameis atalanta*, which has been established on the island of Hawaii for over twenty years[1], was, at least until a few years ago, certainly restricted to that island, and has not even yet been recorded from any other. As is well known, this same butterfly is supposed to be a constant migrant from the European continent to England across a channel comparable with that between Hawaii and its next neighbouring island.

If we consider the endemic species, and examine the 'Cyclothorax' group of Carabid beetles (presumably derived from the Australian region) we find they are very richly represented on the neighbouring islands of Maui and Molokai, central in the group, relatively poorly on Hawaii, with its comparatively great area and varied conditions, much more poorly still on Oahu, and, so far as is known, totally absent from Kauai, the extreme island to the north-west. Though the 'Cyclothorax' beetles have existed a sufficient time in the islands to become so enormously rich in species and to occupy the most diverse situations, where they occur, yet they have clearly been very slow to spread from island to island. The fan-tailed flycatchers (*Chasiempis*) derived also from the Australian region, are totally absent from the three intermediate islands, showing well the chance character of the interisland immigration, in the case of birds, whose ancestors also must have traversed thousands of miles of sea to reach the Hawaiian group. In the Drepanididae, *Heterorhynchus* is unrepresented on Molokai and Lanai, *Hemignathus* on Maui and Molokai, and *Drepanis* (incl. Drepanorhamphus) on Oahu and Kauai. Yet such forms must have required enormous time for their evolution. In none of these cases can the nature of the islands, from which the various animals above mentioned are absent, be for a minute considered as the cause of their absence. In the endemic birds I have elsewhere noticed that there are two elements, one consisting of a few wide-ranging species, widely spread throughout the group (e.g. *Himatione vestiaria* and *Psittacirostra*

[1] Though abundant on Hawaii, in districts visited by him, this butterfly was not found by Mr Blackburn some 30 years ago, so I suppose it reached the island subsequent to his visit there.

psittacea) and a second containing forms restricted to one, or very rarely found on two adjoining islands. This latter group comprises most of the endemic Passerine birds. Even the native crow and buzzard, birds of very great powers of flight, do not occur except on the island of Hawaii.

In insects one notices the same phenomena. In this group, speaking generally, the more widespread forms are usually endowed with powers of flight. Even in the Carabidae, where the vast majority of the species are known only from one island, it is mostly the winged forms that one finds on more than one island, either unmodified, or with species hardly different from one another (cf. *Bembidium teres*, *pacificum* and *molokaiense*, the species of *Colpocaccus*, *Colpodiscus lucipetens*). The winged species of minute beetles of the genus *Cis* are many of them of very wide distribution, so are many of the Lepidoptera. Flightless species are rarely widely distributed. Those species of the Cossonid genus of beetles, *Dryophthorus*, that live in logs, and are extremely tenacious of life, however, are often of wide range. But, as in the birds, hosts of insects with admirable powers of flight are quite confined to one island. The Achatinelline shells, so richly represented on Oahu, Maui, Molokai and Lanai are very poorly represented on Hawaii, and are nearly unrepresented on Kauai, where the great genus *Achatinella* is altogether wanting.

These facts seem to me to show clearly that, with certain exceptions, it must be very rarely that a species passes from island to island so as to become established, and that when this does happen, the immigrant is likely to be isolated for a very long time.

Since in many insects amply endowed with powers of flight, and in the majority of flightless species, there are closely allied but distinct forms in different islands, one may consider that stray examples of a species have only to become separated from the mass of individuals of that species and kept isolated, in order to become in time so modified as to form new species. Where we find an endemic species spread over each or several of the islands, we may suppose either that in such cases the species in question, owing to powers and range of flight, or to other special facilities for distribution, is carried from island to island sufficiently often to prevent isolation, or that, if isolated, sufficient time for change has not yet elapsed. I have elsewhere referred to the fact that there is good evidence to believe that owing to the stability of species, even a great change of environment and isolation cannot be supposed as a rule to affect a species after a few or even a considerable number of generations. That isolation is a most important fact is evident from comparison of the fauna of the several islands. In the Hawaiian group it may be roughly said that isolation is directly proportional to the distance between these islands. If we consider a large, well-collected and much studied genus, such as that of the wasps (*Odynerus*) we find that the comparatively approximated islands of Lanai, Maui and Molokai have many species in common, while Hawaii has few such species, Oahu still fewer, and Kauai, the most remote island, none at all.

We may see forms on the different islands in various stages of becoming distinct species, from the earliest stage, where merely the range of variation of a species is different on two islands, to that where every individual is different, but the differences are so slight as to be hardly specific, and finally to that where the separating characters are too important to be considered racial or varietal, when we may feel fairly confident, that even should a fresh immigration of the original species take place from the one island to the other, interbreeding would not follow.

Modifications following change of environment or isolation are of course subject to the action of natural selection, which may expedite the formation or mould the character of specific distinctions, but even without any selection the original species will be changed if isolated and isolated long enough. It is not improbable that the plastic condition of the species in so many genera, and the extreme difficulty that exists in limiting the species, is really due to the slackness or absence of the agencies, by which natural selection works, the struggle for existence in the case of many of the island creatures having been much less severe than in a more populous and varied fauna.

One might cite any number of cases to show the effects of geographical isolation on specific characters in insects, but one or two simple ones are sufficient. The little bee *Nesoprosopis anthracina* occurs on all the islands from Oahu to Hawaii. It is a xerophilous species, frequenting the flowers of *Sida*, *Vitex*, *Waltheria*, *Tribulus* etc. as well as plants introduced by man. On Kauai only it does not occur, but is there replaced by *N. flavifrons*, very closely allied to it, but quite distinct, with the same xerophilous habits, and frequenting the same food-plants. Another species, *N. facilis*, also found on all the islands but Kauai, is there replaced by an extremely closely allied form *N. chlorosticta* with similar habits. This case differs from the preceding in that both these bees on their respective islands are wide-ranging, and able to thrive in localities very diverse in climate and conditions. They range from the coast to a height of fully 4000 ft. in mountain forests, and yet do not exhibit notable variation under these diverse conditions.

In cases where flightless and sluggish insects are found widely spread throughout the islands, when one would naturally expect modification of specific characters to have taken place on different islands, a careful study of life and habits will probably generally show reasons for the suspicion that isolation is not complete. For instance we are surprised to find a small, flightless and sluggish beetle like *Proterhinus deceptor* on all the islands, little or not at all changed, but we search in vain for distinctions between individuals taken on the various islands. Some variation there may be, but this is no greater between examples from different islands than between others taken on one island. In 1900, and subsequently, I paid some special attention to this case. It was found that this small beetle breeds in profusion in dry regions below any existing forest, in scattered trees, though it also occurs at high elevations in the mountains and under very diverse conditions. It is clearly only restricted from reaching the coast by the presence of introduced predaceous insects, which quickly exterminate it, and doubtless it did once frequent the coastal region. It is one of the few beetles found in the dry branches or stems of those trees, which form a large part of the island driftwood, and being able to adapt itself to very varied conditions of climate etc. and also breeding freely in those trees, which extend right down to the coast, it must have had unusual opportunities for being carried across the interisland channels and also for becoming established when so transported. It even breeds abundantly in the dry, woody capsules of some xerophilous trees. I should consider in this case that the interisland channels have not been sufficient to isolate examples, that may have reached the different islands. Though flightless, we may class such a species with the vagrant birds, *Himatione*, *Psittacirostra* etc. elsewhere alluded to.

It is interesting to observe in animals in which secondary sexual characters of the male are conspicuous, that when geographical isolation has taken place, these are generally modified, in fact herein may apparently be the only modification, as if these sexual characters were often the first to become changed.

It should be noted that specific change may be concurrent with isolation alone, without any change of food or habits, so far as can be observed, though, of course, whether there is really a change of habits is uncertain.

Quite apart from these cases, where isolation on separate islands has induced specific change, we must consider the cases where extremely closely allied species derivatives one from the other, or both from a form hardly different from either, exist on the same island. Of these there are two classes, one in which the closely allied species inhabit only different areas, and the other in which they occupy the same area. In the first case the species are on the same footing as if they inhabited different islands. The best illustration of these is shown by the land Mollusca, of which it is often said that each valley on Oahu has its own peculiar species. It is true that many of the valleys do apparently have their own species, or at least local races, which do not pass beyond, but there are numerous species that have a much more extensive range, either occupying several valleys or ridges, or even having a still wider distribution. It is not accurately known how the *Achatinella* are distributed, but it is quite clear that they can only pass from island to island by a most rare and exceptional chance. This is shown by their poor representation on Hawaii and Kauai, and the fact that of the arboreal species on such islands as Oahu, Molokai and Maui (where they are well represented) there is on each island a specific multiplication of only a few type forms, showing that the present numerous species on a particular island are the produce of only a few earlier established forms. The 'Apex' group of *Achatinella* is peculiar to Oahu, and so with other groups. The sluggishness of the animals would probably make any wide distribution of the

Achatinella on any one island a matter of a very prolonged period were this dependent on their own movements. We once found at the foot of the Waianae slopes a number of one of the terrestrial species of *Amastra*, quite outside the forest, hiding in the hollows of a large log on the bank of a stream. This log had clearly been carried down in a flood, and probably for many miles before stranding, the stream arising in the Koolau range of mountains, the forest of which was miles distant. Once, on Molokai, a young living *Achatinella* was found attached to the feathers of the Drepanid bird *Chlorodrepanis*. Frequently they become adherent to one's clothes in passing through the brush. Doubtless in high winds very young shells are sometimes carried to a distance in curled up leaves, in which they often hide. Once or twice in an open treeless space on Molokai I found shells which must have been carried this way or with small branches of trees during a severe gale. We have known sluggish beetles of the genus *Proterhinus* to be so carried far from their food-plant, doubtless only to perish of starvation.

In 1893 I took the opportunity of paying a good deal of attention to the habits and distribution of some of the arboreal *Achatinella* on Molokai, the shells of that island at the time having been less collected than those on Oahu. It was quite impossible not to be struck with the effect of isolation on individuals of some of these species. *Achatinella macrodon* (Vol. II, Pl. XI, fig. 16) was very common on a ridge close to my camp, but very local, for the next ridge to the west had none of it, nor did I see it on any ridge in that direction. After one had crossed one or two deep gulches eastward, an allied form appeared on the ridges, but with remarkable variations, tending to albinism. On the first-mentioned ridge it was comparatively constant, singularly so for an *Achatinella*. Whether it had once occupied the area between these localities and subsequently died out, or whether by some such means as I have indicated above, it had passed over this area, cannot be known.

Another instance of discontinuity of distribution was examined into, over a large area, in the case of the common and widely-spread *Achatinella tesselata*. This species I found abundant over an extensive irregular plateau, where I had occasion to collect often, at some distance N.W. of my camp. Here the shell was somewhat variable, of good size, and a striking albinoic form occurred. On this same area nine years later I found the shell much scarcer, but again the albino shells occurred. Away from this area and close to my camp on one ridge only, and only on part of this ridge, *A. tesselata* was found in large numbers, but of smaller size than the others, and very uniform both in size and colour, excepting that here it was strictly dimorphic, with two closely similar but easily distinguished and constant varieties. I was not able to find any continuity of distribution between the two areas mentioned, in fact I am sure that such did not exist.

When we consider the sluggishness of these molluscs, it is certain that the individuals of a species on two such areas, though the distance between them in mileage is small, would, but for some chance, remain isolated for ages, if not for ever. How stationary some of these land-shells are, I had many chances of observing, for in some cases I had the same individual under observation for weeks together. A white variety of *Achatinella redfieldi*, which I had occasion to pass by almost daily for many weeks, was always seen at rest just below the fork of a large branch of a lichen-covered Ohia tree. Though there were many showery or wet days, it was never absent from this spot by day, though it may, of course, have moved at night and returned. This was a healthy animal, the shell not at all worn by age. A small dead lichen-covered tree, supporting individuals of *A. theodorei* in 1893, was still occupied by these or their descendants three years later, the adjoining bushes being unoccupied. These shells had the appearance of being a stunted, depauperated form of *A. proxima*, produced by isolation on a wind-swept ridge with its stunted vegetation. In 1902 I looked in vain for this particular colony. To causes, as here given, is due the multiplicity of species or local forms of the Achatinellidae.

Probably few insects are so restricted in range, or so easily kept isolated, as are many of the Achatinellidae, for many of the most sluggish insects are, I think, likely to be more frequently distributed by accidental means than the Mollusca. Still in the insects there are cases known both of distinct species of similar habits and having the same food, which merely occupy a different area of the same island, and of a single species, which, occupying different areas, exhibits different variation in these two areas —or in fact is on the way to form two.

Very often, however, we find species, extremely closely allied, occurring habitually in the same locality and not geographically isolated. Thus, even within a few square yards, the three species of Longicorn beetles, *Plagithmysus darwinianus*, *P. lamarckianus* and *P. varians* occur. It is hardly conceivable that species can be more closely allied than these and remain distinct. Though so similar, the species keep quite apart. Each keeps to its own food-plant, and though occurring on adjoining trees the species do not mix nor interbreed. *P. darwinianus* has been found chiefly on *Sophora*, *lamarckianus* on *Pipturus*, *varians* on *Acacia*. We have observed great numbers of all these species in the field, but have never found even a stray specimen of one frequenting the tree affected by another or in company with it, even though these trees grew side by side. Thus these three species, though not geographically isolated, are isolated by their habits. I know no insects that could be more profitably experimented with by breeding in the field than these and other species of *Plagithmysus*.

It is certainly quite exceptional for a species of these beetles to forsake its proper food-plant and attach itself to quite a different tree, as is evident from the fact that a species in most cases has been found on one kind of tree and only one. It would be of great interest to know whether individuals, bred for the first time on a tree other than the normal food-plant, remain attached to that tree, or wander partly or wholly back to their original food. If we look at the case of *P. vitticollis* and its var. *longulus*, we find a great change of habits concomitant with so little change of the insect that the two are considered to be varieties of one species. The var. *longulus* is the common form, and is attached to a forest tree (*Bobea*), and, as usual, the larva burrows beneath the bark, but *vitticollis* bores out the stems of a species of *Rubus*. Most of the individuals of the latter, so far as the evidence goes, are easily distinguished from the var. *longulus*, so that the two may be considered on the verge of becoming distinct species. It is quite possible that when a *Plagithmysus* first takes to feeding on a new kind of tree, the females, though they may remain attached to the new food-plant, would attract males that have bred on the original one, but when one considers the entirely different nature of the food-plants of such varietal forms as *P. vitticollis* and var. *longulus*, or again of such closely allied species as *P. lamarckianus* and *darwinianus*, the foods of which are trees of quite different orders, with different odour and taste, the one an acacia and the other Urticaceous, one cannot overlook the possibility that this may aid in the isolation of the individuals on different trees. It is a familiar fact how quickly these beetles scent out and arrive at a tree that is their special food-plant, if it be by injury placed in a condition suitable for their oviposition.

In the case of *Plagithmysus bishopi*, of which quite identical examples have been obtained and bred from *Pelea* the normal food, and *Zanthoxylum* as an exceptional occurrence, where these trees grow side by side, the food-plants are much more nearly related and isolation might be less easily attained. Where isolation is complete, in another district of Hawaii, *P. bishopi* becomes *P. vicinus*, though still feeding on *Pelea*, the normal food-plant, but these two species have never been found in one locality. Why certain individuals of a *Plagithmysus* occasionally, but apparently very rarely, leave their proper food-plant to attack some quite different tree, is quite obscure. But on all such matters much further observation in the field is needed.

Sometimes we may find species as closely allied to one another as those above referred to, living actually in company and apparently having similar habits, but it is quite possible that special investigation will show important differences in habits. In the case of the flightless species of *Reduviolus* in the Hemiptera, for example, of which two slightly different forms, probably really distinct specifically, were found in the same habitat, a decided difference in the habits of these forms was observed. The case of the small crickets of the genus *Paratrigonidium* is more similar to that of the beetles of the genus *Plagithmysus*, referred to above, the distinction of habits in these being, as one might say, far more striking than the specific differences. I place the greatest importance on these changes of habits, leading to isolation, in the production of new specific forms.

The extreme variability of many of the insects and mollusca, whether in structure or colour, the indefinite character of the species in many of the genera, e.g. in the

Achatinellidae (Mollusca), the Proterhinidae (Coleoptera) and many other insects, might be considered due to the absence or slackness of those agencies, which elsewhere cause individuals less fitted to the environment to become eliminated. But it is obvious that the lack of definiteness of specific characters may be due to lack of time. When we consider that some of the creatures, which show the greatest individual variation, form a large part of the food-supply of the once extremely numerous insectivorous birds, and therefore might be supposed to have undergone a very rigorous selection, it would appear either that this selection has been singularly ineffective in producing uniformity of appearance in a species, or that the very great variability must be itself advantageous. It is interesting in this connection to compare the great variability of the underside (i.e. the parts exposed when at rest) of the native *Pyrameis* with the usual great constancy of those parts in the immigrant and allied *P. cardui* and *P. atalanta*, in explanation of which it may be urged that these, in their usual localities, undergo a hibernation for many months of the year and requiring therefore a more complete protection, when resting, have arrived at a constancy of markings that suit their resting places. *P. tammeamea*, on the other hand, is active all the year, and brood follows brood without any dormant period of the adult. Spiders of species most liable to be found by birds are often beautifully protected by their resemblance to their environment.

Species which exhibit an extraordinarily wide range of variability, form an interesting study in the islands, for we often find one or more distinct species so closely allied to these as to lead to the suspicion that they actually have been derived from the others. These probable offshoots from variable species are generally much rarer and less widespread than the latter, and probably generally, if not always, differ in their habits. In this case the causes, which have produced them, are similar to those mentioned above of other insects. They have the appearance of being extreme forms of the variable species, as though they had overpassed the limits of variability and become distinct. Their constancy is probably correlated with uniformity of habits.

There are some striking examples of discontinuous variation amongst the island insects, and the same have been noticed in the case of the Achatinellid Mollusca. The di- and tri-morphism in the colour of the legs of certain species of *Plagithmysus* is of a very conspicuous nature, owing to the large development of the femora in proportion to the body, these beetles in a slight degree having a cricket-like appearance. Even more striking are some of the dimorphic forms of the endemic Locustidae (*Banza* = *Brachymetopa*). There is no evidence to suggest from a comparison with allied species that these variations are likely to lead to distinct species, the different forms pairing indiscriminately and not differing in habits. In the case of one species of *Banza* (*blackburni*) a very remarkable form of sexual dimorphism is seen to be resulting from the two forms, but not a differentiation of species. The pairing of the Achatinellidae seems to have been very little observed, and I myself have only three times seen these animals in copula. Two of these cases were pairings between extreme varieties of *Achatinella redfieldi*, and in each case the individuals in copula were of exactly the same colour-form, one pair being the albino variety. The other case was that of another Molokai species, *A. macrodon*, the individuals being identical in colour. No importance can be attached to these few instances.

Reviewing the whole fauna, the widespread effect of segregation in species-formation becomes evident, whether the segregation is brought about by geographical isolation, or by change of food or habits. In the case of very sluggish animals, like the Mollusca, a mountain valley or ridge may prove an effectual isolating barrier, or in fully-winged insects a narrow interisland channel. Exactly how far modification is due to the direct effect of food or difference of habits and how far to the mere fact of segregation is not known, but it appears to me that segregation is the most important. The extraordinary series of well-defined but closely allied species of Homopterous insects, each attached to its own special food-plant, are very interesting in this connection. Considering the fact that individuals frequenting the same food-plant, but geographically isolated, are so often modified as to form distinct species or races, isolation appears the most important factor. The little Drepanid bird, *Himatione sanguinea*, of vagrant habits and inhabiting all kinds of stations throughout the main group of islands, on remote Laysan is replaced by the allied *H. freethi*. A few individuals of the former, chancing to reach that remote island, would probably remain isolated for ages, and this is probably what has happened in the past, the modified *H. freethi* being the result.

Summary of general part of the Introduction.

The Hawaiian fauna cannot be said to belong to any of the great faunistic regions of the globe, it contains most important elements derived from the Oriental region, from the Australian and from the Neotropical or at least from the warmer parts of America, and it cannot be considered as even belonging chiefly to any one of these regions. On present information it is decidedly not Polynesian, but a proper study of the Samoan and other groups may show greater affinities with these than is apparent to-day. The Fijian fauna is extremely unlike the Hawaiian in nearly every respect. The small islands (Christmas, Fanning, etc.) that lie nearly midway between Hawaii and the Samoan group are in sad need of exploration, as also is the latter. Many of the most important components of the fauna are so remarkably isolated (e.g. the Achatinellid Mollusca and many groups of insects richly represented in species) that we cannot even conjecture whence they have been derived. Even the family Drepanididae in the birds has somewhat doubtful affinities, as also has the genus of thrushes *Phaeornis*.

The antiquity of the group must be extremely great. The possibility of an ancient continent, even were it probable geologically, cannot for a moment be entertained by the student of the whole fauna. We should require connection with or approximation to the Oriental region, just as much as to the American continent and Australia. There is no possibility of an ancient land connection having existed even between the islands of the group themselves during the period in which they became colonized by the progenitors of the present fauna. Some groups of insects, considered by themselves, may show nothing actually opposed to this supposition, but others prove it to be quite untenable. Of those who have worked on the material collected by me, I think Lord Walsingham alone has favoured the idea of an ancient continuous land area. But the study of these winged insects is not favourable for forming a conclusion on this point. If we consider other of those that are evidently amongst the most ancient inhabitants of the islands, we see the impossibility of such a theory. The absence of *Achatinella*, s.l., from Kauai at one end of the group, and its almost total absence from the great forests of Hawaii at the other (where only a single type represented by two or three species is known), the presence of *Carelia* on Niihau (until recently) and Kauai, but absent from all the other islands, may be noticed in the Mollusca. The development of highly specialized endemic genera of Finch-like Drepanididae on Hawaii and their entire absence from the other islands, except for a vagrant, ubiquitous form (*Psittacirostra*) and one other (*Pseudonestor*) peculiar to Maui, the island nearest to Hawaii, are noteworthy in the birds. The vast development of species of the endemic flightless genera of Carabidae, allied to *Cyclothorax*, on Maui and its neighbouring islands, their poverty in Oahu, and total absence from Kauai, may be cited in insects. The lack of a single individual of great groups of animals containing countless species, ubiquitous in every land, except very remote Oceanic islands, not only forbids the idea of any continental area, but leads us to conclude that the islands have never been even in past ages much less isolated from other lands than they now are. We have elsewhere shown the difficulty that creatures, whose ancestors must have traversed thousands of miles to reach the islands, have had in spreading throughout the group, and even after ages many have not achieved this. This is certainly more or less attributable to that sluggishness which appears so generally to overtake the descendants of animals that reach the sparsely inhabited forests of these remote islands. On Hawaii we observe even in birds so powerful as the native buzzard and the crow, an unreasonable restriction to that one island, and even to parts of that island. In the Hawaiian islands and elsewhere, the loss of flight of so many insects and less frequently of birds follows disuse. Given sufficient time (and the extraordinary antiquity of the archipelago is manifest) all the phenomena of the fauna are readily explicable on the supposition that a comparatively small number of immigrant species have at various periods been able to reach and establish themselves in the islands. With a disinclination to wander, as seen in the case of the crow and buzzard, above mentioned, it has often taken the descendants of these immigrants ages to spread over the whole group. Some like the Pterostichine beetles have apparently not yet fully done so. Peculiarity seems often in proportion to the isolation, this roughly depending, in the case of the different islands, on the width of the channels between them. Where we study allied species, Kauai has these as a rule most highly modified. Its 'Oo,' *Acrulocercus*, is almost generically distinct from the others, its *Loxops* is the most aberrant, it alone has two species of *Phaeornis*, one being by far the most aberrant, its 'Elepaio' (*Chasiempis*) is the most different, it alone has two distinct species of *Chlorodrepanis*, the one structurally at one end the other at the other extreme of the series, these birds hardly differing on the other islands. Its *Amastrae* in the land-shells have produced the most remarkable of all forms in the subgenus *Kauaia*, and probably from a still earlier immigrant *Amastra* (or antecedent of *Amastra*) has developed the remarkable series of *Carelia*, the young of which are in many ways so like *Amastra* itself. I have reason to believe that in many cases, where we now find the greatest variety of allied species of any group of animals, that island is the place whence all the species originated, or in other words the place where the original immigrants became established. It is difficult to compare one group of animals with another, as regards the importance of the modification that exists, but I cannot see in the existing Achatinellidae any greater modification to have taken place than is observable in the present components of the Hawaiian Nitidulidae, or Anchomenine Carabid beetles, or in the Drepanid birds. It is interesting to note that the island of Hawaii, which is sometimes loosely stated to be the 'youngest' island, is in my opinion the one on which the last-named birds were first established. But it must be remembered that Hawaii is a composite island, and its northern part is of very great age and existed long prior to the bulk of the island, and coincidently with the oldest of the other islands of the group, so that the Drepanid birds may have reached the northern portion, before the rest rose above the sea. The more recent parts have themselves existed for ages and, when their forests became continuous with those of the original island, it would take a comparatively short time for the whole to be occupied by birds. There is no existing genus of Drepanididae which does not occur on Hawaii (unless the Molokai 'mamo' be considered generically distinct from *Drepanis*), excepting the parrot-billed *Pseudonestor* on the next island, Maui, and the crested *Palmeria* of that island and Molokai, a form allied to the vagrant *Himatione*. But Hawaii itself, in addition to all the other Drepanid genera, alone has the specialized *Ciridops* and *Viridonia*, as well as the three more allied genera, *Loxioides*, *Rhodacanthis* and *Chloridops*, indicating excessive antiquity of its avifauna.

Review of the Hymenoptera.

The Hawaiian Hymenoptera are remarkable for the extreme paucity of the number of families of this vast Order, that are represented by endemic species. The saw flies or Phytophaga, considered by some as a sub-order, are totally unrepresented. Ashmead in 1900 recognized 94 families in the Hymenoptera, and this number may be taken as approximately correct, for while some of these groups are in our opinion unworthy to rank as families, yet others are formed of discordant combinations of genera, which he freely admits are of quite different ancestral origin, and a proper classification of these will make good any loss in number caused by the sinking of groups, that he considered as distinct families.

Excluding forms that are known to be introduced, or from various kinds of evidence are almost certain to prove so, the endemic Hymenoptera represent only the following families: (1) Prosopidae, (2) Crabronidae, (3) Pemphredonidae, (4) Eumenidae, (5) Bethylidae, (6) Poneridae, (7) Proctotrypidae, (8) Diapriidae, (9) Scelionidae, (10) Mymaridae, (11) Figitidae, (12) Miscogasteridae, (13) Encyrtidae, (14) Pteromalidae, (15) Eulophidae, (16) Ichneumonidae, (17) Braconidae. Moreover of these 17 families four are only represented by a single species that can really claim endemicity (Poneridae, Proctotrypidae, Pteromalidae, Braconidae), so that these can be looked upon as comparatively recent additions to the endemic fauna. It will be seen that I have excluded a number of families, which contain species not at present known outside the islands, and it is possible that a few of these species are really endemic, though I think this is unlikely.

I will now refer to those more or less doubtful species which cannot positively be considered as foreign importations, as well as to some of those that are without doubt of human introduction. In the latter class are *Xylocopa brasilianorum* (*aeneipennis*), *Megachile palmarum*[1] and *M. schauinslandi*[1], and *Apis mellifica* amongst the bees. Only two of these insects, the *Xylocopa* and *Apis*, occurred to Blackburn, when collecting, and as the two *Megachile* are very common Honolulu insects and, further, have spread widely thence in the last 17 years, we can be sure they have been imported and were not present in the islands even 30 years ago. *Apis* and *Xylocopa* are of earlier introduction, the latter being well known to have been non-existent here till long after the settlement by foreigners. It was no doubt brought from the warm parts of America, when formerly ships visited the islands frequently from that region. In the Fossorial group an American *Stigmus* was once taken in the middle of the town of Honolulu and appears to have not established itself, while a *Sceliphron* of early introduction from America (known, however, not to have been present before the foreign settlement) and a *Trypoxylon* of recent importation from China, are now both widely spread and thoroughly naturalized. Both these insects are semidomestic in habits.

[1] The former of these is now known to me from California, the latter from China.

The two species of *Pison*, mentioned in my account of the Hymenoptera, published in 1899, have now a third congener of quite recent introduction, it having first appeared in 1903. All these frequently breed in or on the woodwork of houses, in cavities in chairs or furniture, etc.

The two Asiatic wasps, *Polistes macaensis* and *hebraeus*, of wide distribution, and the American *P. aurifer* are also certainly importations by man, being quite unknown in the earliest days of foreign settlement; in fact of the two former species *P. hebraeus* was of late introduction, not having occurred to Mr Blackburn, nor was it generally spread over the islands 20 years ago.

Several Bethylidae are more or less frequent household insects, being doubtless parasitic on others, which attack grain and other produce, or burrow in woodwork. Such are the species of *Epyris* and others undetermined.

Of the ants, I think all those now existing may be considered as importations, excepting a variable *Ponera*, chiefly found in the forests, and clearly intolerant of the presence of most of the foreign forms. It is, however, quite probable that other endemic ants have previously existed and become totally exterminated before collections of insects were made.

It is not necessary here to detail the minute species of the Chalcidoid and Proctotrypoid series that are clearly introduced, but I will now turn to several Hymenoptera that are not so clearly introductions by man.

Of the bees we have *Megachile diligens*, a species found by Blackburn in Honolulu more than thirty years ago and still occurring in gardens in the town. Now, however, it is widely distributed over all the islands, but shows no noticeable variability, and, so far as I have observed, forms its tubular leaf-cells always from plants of foreign origin. It will almost certainly be found elsewhere. Clearly the Megachilidae are easily imported in lumber or furniture, as since Blackburn's time *M. palmarum* and *M. schauinslandi* (both of which commonly nest in houses or furniture, the latter not using leaves, but filling the key-holes of the doors with resinous wax) have appeared, and later still (in 1900) the black *Lithurgus albofimbriatus* was established.

In the Chalcididae, *C. polynesialis* is a doubtfully imported species, which still occurs in gardens in Honolulu, but its presence is now masked by the swarms of *C. obscurata*, introduced for economic purposes. It appears to show considerable variability. *Epitranus lacteipennis* still occurs rarely in Honolulu, where its habits are not known. Another Chalcidid is of late introduction, having appeared about 1900.

The Evaniid, *E. sericea*, will almost certainly prove to be foreign; it is bred from the ootheca of foreign cockroaches.

The Braconidae, excepting the Spathiine, *Ecphylopsis nigra*, are almost certainly all foreign, though some were taken by Blackburn more than 30 years ago. The two of these that seemed most likely to prove endemic were *Ischiogonus palliatus*, which so often attacks the endemic longicorns, and *Microdus hawaiicola*, but the former, which also destroys larvae of imported longicorn beetles and apparently those of other families, is now known elsewhere, and the latter is a parasite of introduced Tineid moths and known also from Fiji.

To return now to the families that are represented by positively or probably endemic species, we shall see that though the number of species is frequently large in these, proportionately to the size of the islands, the number of genera represented is very small.

The Prosopidae are represented by 53 described species of one genus *Nesoprosopis*, which is not endemic, since an European[1] species agrees with the Hawaiian series in its essential characters.

The Crabronidae contain five genera closely related, as it appears to me, to one another, but sufficiently distinct from foreign forms to be separated generically. The European *Crabro vagus* is related to the least remarkable of the Hawaiian species. None of the other diverse groups of *Crabronidae* have any representatives in our fauna. There are 18 Hawaiian species.

The Pemphredonidae have two well-marked genera in the sub-family Pseninae. They are intimately related to one another and no doubt of common origin and are allies of the widely spread genus *Mimesa*. There are 10 species, equally divided between the two genera.

The Eumenidae are represented by 104 species, included in the almost ubiquitous genus *Odynerus* together with three other genera that are endemic. These three genera, however, are intimately related to some of the island species assigned to *Odynerus* itself and are evidently local derivatives from the same stock, produced within the islands. Those assigned to *Odynerus*, on the other hand, are, I now think, clearly descendants of two quite distinct forms of original immigrants, one of which gave rise to the bulk of the species, as well as to the endemic genera that I have separated from these, while the other has produced but four distinct species, as at present discovered, and its origin was Asiatic.

The Bethylidae (incl. Dryinidae) have four genera represented, none of these being endemic. *Sclerodermá* has 10, *Sierola* nine, *Pseudogonatopus* two, and *Echthrodelphax* a single species. The latter may not impossibly prove to be specifically apodemic, as well as generically. It is of Australian origin, as also is *Sierola*.

The Poneridae are represented by one endemic species of *Ponera*, which exhibits much variability, the variation being apparently due to local influences to some extent.

The Proctotrypidae have but a single species of *Proctotrypes*, parasitic on endemic Diptera in the forests. It is said to be allied to a North American species.

The Diapriidae are represented by three described genera, one of which is not endemic and the other two appear to me to be derivatives of the latter. One in fact

[1] A species, *N. chinensis*, is now known from China.

seems hardly more than a flightless form of the apodemic genus *Phaenopria*, under which I have described species. Probably, however, Hawaiian *Phaenopria* will prove generically distinct from species in other countries. There are nine described species, and doubtless a good many more remain to be discovered.

The Scelionidae are represented by six species of *Anteris*, and a single one of *Bacus*, which belongs to a different sub-family. All are truly endemic, as also may be one at least of the genus *Telenomus*, representing yet another sub-family.

The endemic Cynipoids belong all to the family Figitidae, and to one sub-family of this. Though placed in a number of genera, one of which was described as new, by Ashmead, the rather numerous species that are known appear to me to be all related to one or two types, and probably should be assigned to not more than two or three genera, a view taken by Kieffer without examination of specimens. They present great difficulties in determination, but 23 species have been described without dealing with male examples, which cannot certainly be referred to species of the other sex. I here treat the Hawaiian forms as belonging to only two genera.

The Mymaridae are represented by 15 species of the genus *Polynema*, other groups (sub-family and tribes) being unrepresented.

In the Chalcidoid series the Miscogasteridae have 10 species, placed in four genera and two sub-families, but the characters distinguishing these sub-families are very slight, and I have even had some doubt whether there is any real generic difference between some of the Hawaiian species referred to, the chief genera representing the two sub-families. Some undescribed species are known to me, and doubtless a good many more remain to be discovered. Two of the genera representing the sub-family Lelapinae are endemic. The Encyrtidae is perhaps the most important family of the Chalcid super-family, the sub-family Eupelminae being represented in all by four genera, one of which is supposed to be peculiar (*Solindenia*). The single *Anastatus* is clearly imported, being parasitic on eggs of a Locustid, known to have been introduced, nor is it very certain that *Eupelminus*, represented also by one species, is really native. *Solindenia*, the endemic genus (also with only one species), is less liable to suspicion, but not altogether free therefrom, for it certainly occurs, where no endemic host is found for it to parasitize.

Eupelmus, on the other hand, contains a large number of endemic species, 54 having been described. They are of very varied habits, and as Ashmead recognized but few in the large number of examples that he handled, I fancy he must have lumped together a number of distinct forms. Perhaps I have myself separated them too minutely.

The Encyrtinae are represented by six species of the genus *Anagyrus*, which appear to be endemic. This however is uncertain until their habits have been studied, since in other countries the genus attacks Coccidae, and therefore numerous species might easily have been imported with scale insects, accidentally, or perhaps in some cases intentionally by Koebele. The members of the tribe Mirini I look upon as foreign, with perhaps one or two exceptions.

The vast complex of forms included in the Pteromalidae can only be said to be represented endemically by a minute *Spalangia*, a true forest insect, allies of which may be expected to be found.

The Eulophidae have a greater number of genera containing endemic species than the Encyrtidae, but in most of these only one or two species have been described. The Aphelininae and Tetrastichinae are foreign and need not be considered. The Entedoninae, Elachistinae and Eulophinae must be considered as having endemic species. These include seven genera and only eight species, as described. This, however, gives an erroneous impression of the group, for a good many more species have been collected (in several of these genera). After death most of them rapidly dry, and distort to such an extent as to utterly unfit them for description.

The vast group of Ichneumons are represented only by a single endemic species of *Echthromorpha* and two of *Glyptogastra* (an endemic genus) in the Pimplinae; in the Ophioninae by three endemic genera *Banchogastra*, *Pycnophion*, and *Pleuroneurophion* (six species in all), as well as a large number of endemic species in apodemic genera. *Ophion* has one species, *Enicospilus* 13, *Eremotylus* 1, *Athyreodon* 2, *Atrometus* 11, *Limnerium* (1), *Lathrostizus*[1] + *Ideethis*[1] 2, *Pristomerus*[1] 1. The claims of the species in the four latter genera to be endemic are, however, more or less doubtful, and one other species of *Limnerium* is certainly introduced.

The Alysiidae and Braconidae are, doubtless, all foreign, excepting only the minute *Ecphylopsis nigra* (the genus being endemic) of the sub-family Spathiinae.

There are therefore 52 genera in the Hymenoptera represented by endemic species (though in a few cases the endemicity of these is questionable) and these species number 372, or seven species to a genus on the average. If we exclude those questionable species, the average would be rather higher still.

Comparing the Aculeate Hymenoptera, i.e. ants, bees and fossorial wasps, with the remaining families or 'Parasitica,' we find in the former only 13 genera with 186 species, an average of about 14 species to the genus; in the latter 39 genera also with 186 species, an average of 4·7 to the genus.

This very great difference in the average of species in the two groups will no doubt be subject to considerable alteration and will not prove so vast, as now appears, though I believe it will remain considerable. In many cases, owing to their specialized habits, the parasitic forms have less scope for a great increase of species owing to their dependence on a limited number of hosts. Thus the Eulophidae, several of which are parasitic on leaf-mining caterpillars, are limited in species by the comparative scarcity of species of Lepidoptera having these habits.

[1] Further observations render it certain that these have been introduced.

On the other hand we find that the genus *Eupelmus*, which can adapt itself to very varied hosts, attacking eggs, larvae, and pupae of other insects, and various orders, e.g. Coleoptera, Hymenoptera, Diptera, Orthoptera and Neuroptera, in the small limits of the islands, has produced an exuberance of species.

But we must also make allowance for the minute size and hidden life of most of the Parasitica, as compared with the comparatively obtrusive presence of the Aculeata, rendering the latter so easy to collect. And still further, while the bees and wasps are comparatively of large size, presenting obvious characters for specific separation in sculpture and general appearance, as well as others afforded by the genitalia, mouth parts etc., which are easily examined in larger insects, the minute forms, included in the Parasitica, are much more difficult to discriminate. The closely related species of *Odynerus*, inhabiting different islands, if reduced to the size of Mymarids, and subject to post-mortem distortion, like these and the smaller Chalcidoids, might in many cases prove impossible to separate.

Of the 52 genera, that contain presumably endemic species, 17 are, so far as our present knowledge goes, themselves endemic. While 10 of the 13 aculeate genera are considered endemic, only seven of the 39 parasitic genera are so. This, however, is not of any great significance, but merely indicates that in the larger Aculeata it is possible and convenient to distinguish groups of Hawaiian species from one another or from allied genera in other countries.

Prosopidae.—All the Hawaiian species belong to a single genus *Nesoprosopis*, which I made for these island forms, not knowing at the time that similar characters existed in foreign *Prosopis*. Subsequently by a curious coincidence, when collecting in England, I discovered a bee, new to the English fauna, having the essential characters of *Nesoprosopis*. This species is the *Prosopis kriechbaumeri* of the European lists. Although I have examined the structures in numerous European, Australian and American[1] *Prosopis*, I have not yet found any other species allied to this European form, nor, consequently, to the Hawaiian ones. It is greatly to be regretted that the terminal segments, which exhibit such fine characters for specific and generic separation, are generally entirely neglected by describers of Prosopidae, so that for American and Australian species I have had to rely entirely on my own observations. Possibly it will be found that the European *P. kriechbaumeri*, or others allied to it, extend their range, like other insects, across Asia, and this would point to an Asiatic[2] origin for the Hawaiian *Nesoprosopis*. There is no doubt that had *P. kriechbaumeri* been handed to me amongst a collection of Hawaiian species, as coming from the islands, I should not have hesitated to consider it as an endemic

[1] An excellent paper on these has been published by Mr C. W. Metz (Tr. Am. Ent. Soc. XXXVII, p. 85) since this paragraph was written.

[2] A species has now been discovered in China by Mr J. C. Kershaw.

form. It is most nearly allied to the Hawaiian species of the *N. longiceps* group. The Hawaiian *Nesoprosopis* form a very varied assemblage, tending to split up into a number of genera or sub-genera. The superficial differences between such extremes as *N. crabronoides* and *N. paradoxica* are extraordinary, but throughout the whole series of forms the essential characters of the genital armature and seventh and eighth ventral segments remain the same, and bear strong evidence to the taxonomic value of these characters.

The *Nesoprosopis* are almost the most ubiquitous of any Hawaiian insects. They are found in the hottest and driest coastal regions, when vegetation springs up after the rains, and in the mountains extend their range far above the forest line to the limits of vegetation. Some of the species frequent the most different stations, e.g. *N. volatilis*, which has been found on the hottest coasts and at all elevations in the mountains to a height of 9000 ft. in the region of snow in winter time. Many range from the coast to about 4000 or 5000 ft. above the sea, especially *N. facilis* and allied species. Others are purely littoral or range but a short distance inland, e.g. *N. longiceps, blackburni, hilaris* etc. The members of some of the groups, however, confine themselves to similar stations. Thus the small or moderate-sized short-faced species of the *N. laticeps* group are only found in more or less dense forests, where there is much shade and constant dampness. The large forms with punctate abdomen are also true forest insects. Some species exist in, and in fact favour, the wettest and densest forests in the islands, where the ground is always saturated with rains or in the condition of a bog. *N. laticeps* and *N. satelles* seem to thrive in such situations.

In their nesting habits there is considerable variety. On the coast or lowlands, or where the soil is sufficiently dry or sandy in the mountains, many form their burrows in the ground, often, however, availing themselves of the pith cavities of dry branches or twigs. Those frequenting denser and wetter woods in the mountains, of necessity, burrow in dead tree stems or in hollow branches. Some affect the hardest tree-trunks, e.g. of Ohia (*Metrosiderus*), sandal-wood, Mamani (*Sophora*) and utilize, when they can, the borings of xylophagous beetles. Trees like the Lobeliaceous *Clermontia*, the dead branches of which are hollow, and afford a fine protection against the damp, are frequently colonized by the larger species, such as *N. fuscipennis*. Some of the species seem to be of solitary habits and are rarer, while others sometimes form great colonies, whether in the ground (e.g. *N. difficilis, facilis*, and many others) or in dead tree-trunks, hard or rotten (e.g. *N. paradoxica, melanothrix*, etc.).

Being so widely distributed, naturally a very great variety of plants are visited by the different species in search of honey and pollen. On the coast and lowlands, foreign, immigrant plants are mostly visited. The chief of these are *Sida, Waltheria, Vitex, Capparis, Scaevola* and *Tribulus*. In the same situations, where the forest trees do not extend to the lowlands, a few endemic plants are also visited such as

Hibiscus brackenridgei, composites such as *Lipochaeta* and depauperated forms of *Santalum*. These lowland bees have taken freely to many introduced plants, such as *Prosopis* and other acacias amongst trees, as well as garden flowers of various kinds. In the mountains the Ohia tree in general is visited by all species of the genus, as it affords abundance of nectar easily reached by these short-tongued bees. Many other flowers are attractive in their season, *Acacia koa*, *Straussia*, the mountain species of *Scaevola*, *Rubus macraei*, etc. In the regions of frost and snow, *N. nivalis* and others are partial to the flowers of *Cyathodes*. In some forests, where a foreign *Rubus* has become a pest, they visit these flowers in great abundance. The different species of these bees by no means restrict their attention to one kind of plant, but collect from the most diverse kinds.

The most interesting fact in connection with the Hawaiian Prosopidae is that a small group of five species of *Nesoprosopis* has become inquilinous or parasitic on their industrial congeners. As is well known, amongst bees in general, parasitism of this kind has arisen independently in various groups. Thus the Megachilidae (sens. lat.) have given rise independently to the *Coelioxys* group of parasites (Coelioxinae Ashm.) through forms allied to *Megachile* itself, and to the *Stelis* group of parasites through forms allied to *Anthidium* (Anthidiinae Ashm.). The Anthophoridae have given rise to the parasitic *Melecta* group (Nomadidae *partim* Ashm.) while the origin of some other parasitic forms is still involved in doubt. The case, hitherto known, in which the least modification has taken place between host and parasite in bees is that of *Bombus* and *Psithyrus*, where the males differ very slightly in structure, although Ashmead has gone so far as to make these genera represent distinct families. In all these cases the main difference between the parasite and the industrial form, from which it has sprung, lies in the disappearance of such structures as are concerned in the gathering of food for the nurture of its young, and therefore the female parasite is chiefly affected in most cases. This is likewise the case in the parasitic *Nesoprosopis*, the distinctive curved hairs of the front tarsi, whereby the pollen is swept towards the mouth, having undergone obvious modification. I cannot, however, see the slightest character, whereby the males could be separated generically from the industrial forms; some of them indeed are not too easily separated from the latter specifically. It may be supposed that these Hawaiian species show the earliest stage in modification of industrial bees into parasitic, as at present known. Their parasitic habits are complete, that is, the parasitic forms never store their own cells.

The cells of *Nesoprosopis* are translucent and of dry gelatinous appearance, being impervious to the fluid honey stored therein. Such pollen as is mixed in this honey, is regurgitated with it, since the Prosopidae possess no external arrangement for carrying a load, as do most industrial bees. Rapid inward strokes of the front feet, which, as has been said, are provided with special hairs, sweep the pollen grains from the anthers of the flower towards the mouth.

A good many of the species of *Nesoprosopis* exhibit considerable variability and this not merely affects superficial characters, such as the facial or other markings, but important structures are involved. Thus in *Nesoprosopis flavifrons* I have noticed variation in the amount of dilatation of the scape of the antennae, so that, in this respect, some examples more nearly resembled the allied *N. anthracina* than did others. Similar variation has been noticed in other species having a strongly dilated scape. The small median facial plate above the clypeus sometimes varies in its relative length and breadth. In the case of *N. difficilis* and *N. volcanica*, two very similar species, often occurring together, I found that the majority of many specimens that I examined could be distinguished by the shorter supraclypeal plate of the former, but that examples occurred in which this distinction was not maintained. These two species, I should add, are perfectly distinct by other constant characters.

Some of the parasitic species are especially variable in size, and this variation is often striking, when examples from different localities are compared in series. It is due entirely to the amount of food supply consumed, and this amount depends on the species of the host, in the nest of which the parasite is nurtured. On one occasion I obtained specimens of *N. volatilis* of gigantic size for this species, these having been bred in a colony of *N. assimulans* var. *oahuensis*. The same species when obtained from colonies of *N. lacta* or *N. difficilis* is much smaller. In some localities one may find very large and very small examples of *N. hilaris* in the same station, the former being bred on the store of *N. assimulans* and *longiceps*, the latter on that of *N. blackburni*. As will be seen from these remarks, the parasitic *Nesoprosopis* are not at all confined to one species of host. However, they only infest the nests of such species as burrow in the ground. Those that burrow in the trees have never been found to be affected.

These latter, however, have their true parasites (i.e. not inquilines, as the others would be more correctly called) in the shape of the Encyrtid Chalcidoids of the genus *Eupelmus*, which are bred from the cocoons of some of the larger species, and very probably affect the smaller also. On one occasion I saw an extraordinary congregation of males of one of these *Eupelmus*, forming a complete circle around the entrance of the burrow of *Nesoprosopis setosifrons*, the heads of all the parasites resting on the edge of the mouth of this burrow. Their antennae were kept in constant vibration and those of each individual were continually crossed with its neighbour's, evidencing great excitement. No doubt the burrow, which was one of several in a very hard dead tree, would, if opened, have revealed one or more females of the *Eupelmus* ready to emerge. *N. fuscipennis*, a species common in the mountains near Honolulu, is attacked by the same or an allied parasite, as also is its var. *obscuripes* on Maui.

Many of the species of *Nesoprosopis* are extraordinarily abundant and I doubt whether any species is really rare. Some of them appear at irregular intervals and so in any locality are easily missed. My experience with the remarkable little

N. crabronoides well illustrates this point. Originally, with difficulty, I obtained a few females, and on various other occasions at the same place and time of year failed to find even one. Yet on another occasion, also at the same season, I observed many scores in a few hours in this same spot. Similar instances have frequently been noticed, and a species which is abundant one year in the summer months may on another occasion appear at quite a different season in the same locality. It is in some respects rather interesting to note that the Hawaiian *Nesoprosopis* most nearly allied to the one apodemic species are the littoral species of the *N. blackburni* group, while the forest-frequenting forms include those most extremely divergent from these.

Comparatively few of the species are distributed over many of the islands of the group, but *N. facilis* and *difficilis* are found on all the islands excepting Kauai, where the former is represented by an extremely closely allied form, and *N. laeta* occurs on all. Several species are common to the three neighbouring islands Lanai, Maui and Molokai. Many are peculiar to a single island and further investigation is not likely to prove this incorrect in the case of a good many species. Thus *N. setosifrons* is represented on Oahu by *N. anomala* and on Kauai by *N. perspicua*, while at present no corresponding form has occurred on the other islands. *N. insignis* of Hawaii is represented on the three intermediate islands by *N. satelles*, and probably on Kauai by *N. andrenoides*, while no corresponding form has so far been found on Oahu. The *N. dumetorum* group has an allied species peculiar to each island, excepting Oahu and Molokai.

As far as our present knowledge goes, the endemicity of the species as regards islands is as follows: Hawaii has 18 species endemic, Maui 6, Molokai 1, Lanai 1, Oahu 3, Kauai 8. It is clear that the interchange of species between the three neighbouring intermediate islands is much easier than between others of the group, although Maui, a large island, with great variety of natural conditions, contains six endemic species. If we treat these three islands as one we find that together they have 13 that are not found on other islands, each in fact being well endowed with species of the genus. Thus the small island of Lanai has no less than 14 species, while but one is endemic, and even that one is likely to be found on Molokai. Oahu seems to be poor in its Prosopid fauna, only 11 species being at present known (or three less than on little Lanai), but of these three are endemic. Kauai is poorest of all in number of species, only nine being known, but eight of these are endemic. Hawaii stands alone in the richness of its species, which number 24, and no less than 18 are endemic. These figures no doubt are subject to slight alteration, for in one or two cases species described as distinct in Vol. I, pt. 1 of this work are likely to be sunk, as being merely varieties. I should add that since this part was published several species have been found to have a wider distribution than is indicated therein, and in the figures given above these new localities have been taken into consideration.

XYLOCOPIDAE.—*Xylocopa brasilianorum* (or *aeneipennis*) is an abundant and even injurious species, since it does considerable damage by riddling fence-posts, telephone poles and other wood with its borings. It also burrows in living trees, but I think only in the dead parts or such as are nearly dead, choosing generally the softest kinds of wood. I think there is no doubt that it was imported by man in lumber. It was unknown until after the islands were settled by foreigners. It is interesting to note that its habits are such, as might have enabled it to reach the islands by natural immigration, for it is particularly fond of breeding in dead logs on the sea-beaches, especially in the very light, dry logs of the 'wiliwili' (*Erythrina*). It is also very partial to the dead branches of this tree, when still growing. This *Xylocopa* chiefly inhabits the littoral or low mountain regions. It visits many kinds of flowers, especially papilionaceous ones. The larvae and pupae are often destroyed wholesale by the foreign ant *Pheidole megacephala*, which enters the burrows in swarms, and we have seen a whole colony of the bee eliminated by this minute enemy.

MEGACHILIDAE.—The three *Megachile* are probably all introduced, two indeed are of recent importation and have increased their range and numbers enormously in the last 16 years. *M. diligens* is widely distributed over the islands, but shows no local variation. It was found by Mr Blackburn in Honolulu more than 30 years ago, but we have no record of its distribution at that time. It still is found in the gardens in Honolulu. In the country it is generally found along the coasts or lowlands. Its nests are formed of leaves of various imported Acacias. On sandy coasts we have observed the bees very plentifully in the flowers of *Ipomoea pes-caprae*, but it visits those of other naturally immigrant or native plants, and in gardens in Honolulu has been taken on *Cosmos*, *Plumbago* and various introduced flowering shrubs.

M. schauinslandi is, I have little doubt, an Asiatic importation. It is not a leaf-cutter like its two congeners, but seals up keyholes and cavities, in which it breeds, with masses of resinous matter. It is extremely abundant in gardens in Honolulu, visiting many kinds of flowers of cultivated plants as well as weeds.

M. palmarum was probably introduced about the same time as the preceding and is also very common and now widely distributed. Its nests of the usual leaf-formation are often found in houses in holes or crevices, e.g. between the slats of window blinds. They have been found in large numbers concealed in leaves of various palm trees, which had been rolled and spun together by the caterpillars of *Omiodes blackburni*, an injurious Pyralid moth. It visits many kinds of flowers, cultivated and other.

A still more recent importation, at present found only on Oahu, is a species of *Lithurgus*[1], which was first noticed in some numbers in 1900. It is locally abundant and widely distributed over this island. In some remarks that I published elsewhere on this species I stated that the labial palpi were four-jointed, in error, for there are but

[1] Determined for me by Prof. Cockerell as *L. albofimbriatus*, found in Tahiti. Probably an introduction into both countries from the Oriental region, whence I have seen forms hardly different.

three joints, the terminal one having in some aspects an appearance of forming two. The mouthparts of *Lithurgus* are, as I have pointed out, extremely unlike those of ordinary Megachilidae, the tongue being extended far backwards along the breast. This species nests in wooden posts, sometimes forming extensive colonies. We have seen such a colony in the upright posts supporting a house in the Nuuanu valley, and others elsewhere. The bees are very partial to the flowers of *Ipomoea pes-caprae* and other Ipomoeas. Sometimes many examples may be found asleep in these flowers, after they have closed up for the day. This species is I believe of Asiatic origin.

PEMPHREDONIDAE.—The Mimesidae, which in the systematic account I considered a family, are perhaps better treated as only a sub-family of the Pemphredonidae.

The two genera represented have I think certainly originated from one ancestral immigrant form, the home of which is quite uncertain, as the genus *Mimesa*, to which they are allied, is of wide distribution, inhabiting both the new and old worlds.

The Hawaiian forms are easily distinguished by the great length and slenderness of the basal joints of the antennal funicle, the long petiole, and the remarkable head structures of the females. In the one genus these consist of a remarkable genal spine, in the other of a peculiar modification of the clypeus.

In most of the species of *Nesomimesa* the genal spines vary much in development, but the form in examples, in which they are fully developed, is more or less characteristic of the species. This great variability renders their specific separation difficult and the males are extremely similar in all the species. In *Deinomimesa* on the other hand the clypeal structure does not appear to vary to any noteworthy extent, though some of the species vary a good deal in other structures.

It seems quite certain that both these peculiar structures are in some way connected with the capture of their prey; in the one case (*Deinomimesa*) the effect is to produce a kind of large spurious mouth opening, in the other (*Nesomimesa*) the long fringed mandibles, when agape, and the pendent spines also form a sort of trap for the seizure of the prey. The variation in individuals in the development of these spines is very remarkable, for they are frequently extremely reduced in size. One would suppose that a structure of this nature and importance would be quickly brought to a state of great constancy by the operation of natural selection. On the supposition that I am correct as to the use of these spines, and it is difficult to doubt this, the variation exhibited by most of the species is very surprising. I believe the Kauai species, which is more distinct from the others, than they are from one another, is nearly constant in the form and development of its genal spines.

As in the other endemic species of Aculeate Hymenoptera, occasionally one meets with specimens of these insects in which the abdomen is of a reddish colour instead of black, a familiar variation in many kinds of Aculeates in other countries, and apparently due to the adults having preserved the coloration of immaturity.

All the Hawaiian species of both genera are true forest insects and most of them may be seen in large numbers, where they occur, flying round ferns and bushes in sunny places. The males are often much more numerous apparently than the females, but this is due to the more retiring habits of the latter, which, when they have begun to provision their nests, frequent dark, shady and damp places in search of their prey. This consists of the endemic Limnobiidae or daddy longlegs, which live in such places. On one occasion I saw a number of *Nesomimesa hawaiiensis* endeavouring to catch Fulgoroid leaf-hoppers, that were running on a small tree-trunk, but they were quite unsuccessful in their attempts, the hoppers when pounced upon always hopping off in safety. Although I have often watched females of these wasps returning with prey to their burrows, it was always Tipulidae that they carried to the nest. Their burrows are usually made in the ground and are often drilled down from beneath a stone, this no doubt serving to keep the burrow sufficiently dry. Sometimes numbers form their burrows close together and I have found such colonies of *Nesomimesa* and *Deinomimesa* mixed, a favourable slope and soil attracting both alike. On a few occasions *Nesomimesa* has been observed to form its nest in tree trunks, probably utilizing the boring of coleopterous insects.

The parasitic Chrysididae, which so often attack Pemphredonids in other countries, are wanting in our fauna and, so far as is known, the Hawaiian Mimesae have no parasitic enemies. On one occasion I took the male of *Nesomimesa nitida* from the stomach of a thrush (*Phaeornis*) on Lanai. The comparative scarcity of prey appears quite sufficient to prevent their becoming more numerous than we find them, in fact one is rather astonished that they can procure sufficient to become so common as they are.

Excepting *Nesomimesa nitida*, which is found on each of the three adjoining islands Maui, Molokai and Lanai, all the species of the genus and *Deinomimesa* are confined each to a single island. The latter genus is at present unknown on Oahu, Molokai, Lanai, but has two species on both Kauai and Hawaii. *Nesomimesa* has two species on Kauai, and one on each of the other islands.

CRABRONIDAE.—The Hawaiian Crabronidae are represented by 18 described species, which I have distributed in five genera. All these forms appear to be closely allied and, as it appears to me, might well be the descendants of one original immigrant form, allied to *Crabro vagus*. To this latter there are closely allied species in China and America, and for this reason the Hawaiian forms may be either Asiatic or American in origin. The Australian forms are very different. Of the 18 species represented, three represent each one a distinct genus, while another genus, *Nesocrabro*, contains four species, so that the greater part of the known forms fall into one genus, *Xenocrabro*, of which the others appear to be simply derivatives, and it is to species of *Xenocrabro* that the European *Crabro vagus* is most nearly related.

Unlike the other endemic fossorial Hymenoptera (*Nesomimesa* and *Deinomimesa*) the Hawaiian Crabronids are ubiquitous, occurring both on the coast, in open mountain localities and in thick forests. Some species indeed, e.g. *X. unicolor*, occupy all such stations, and I have found this to occur in wetter and denser forests than any other wasp, and where only a few species of bees otherwise represent the aculeates. Many of the species are extraordinarily numerous in individuals, and we have seen around a dead cow, on which flies were abundant, a swarm of one or two species of *Xenocrabro* almost as large as that of their prey. I several times noticed when I had shot a deer on the island of Molokai, that one or more Crabronids would arrive and settle on the body before this was even cold, awaiting the arrival of flies. One may well suspect that at the present time the number of individuals of these wasps is much greater than was the case under natural conditions of the fauna, unless, indeed, the endemic Dipterous population has very much changed. The swarms of dung- and carrion-eating Diptera, that now exist in the mountains, can have had no place in the original fauna, and on many of these flies the wasps now largely prey. Even the common house fly is not exempt, and at the Volcano-house hotel on Hawaii *X. atripennis* has often been seen entering the room and taking the flies on the window panes. If we consider such flies as *Sarcophaga pallinervis*[1] (described from the islands) to be endemic, even these can now breed in numbers previously impossible, owing to the great number of cattle that have been introduced, and furnish food for their larvae. Another favourite prey of the Crabronids of to-day consists in two common species of parasitic Tachinid flies, both foreign.

The natural prey of the species of *Nesocrabro* is certainly the remarkable and comparatively rare Sarcophagid flies of the endemic genera *Dyscritomyia* and *Prosthetochaeta*. They have several times been caught, when carrying these, and a burrow of *N. stygius*, that was opened, was found to be packed with a small species of one of them. We have taken the same flies from nests of other of the Crabronid genera, but they are not restricted to these. *Hylocrabro tumidoventris* sometimes provisions its cells with a moderate-sized species of *Drosophila*. Some of the smaller species of *Xenocrabro* are fond of preying on the Anthomyiid *Lispe*, and we have found others carrying species of *Caenosia* of the same family, all these being endemic species. One species of the wasp by no means restricts itself to one kind of prey, nor even always to kinds at all similar, for *Xenocrabro hawaiiensis* on one occasion was caught carrying off *Lispe* and on another occasion a species of the Limnobiid *Dicranomyia*! This fact is of some interest, because the latter is the habitual prey of *Nesomimesa*; and it shows that the Crabronid can successfully capture the same without the aid of special apparatus. *Xenocrabro unicolor* has been seen to capture and carry off the recently introduced and showy *Neoexaireta spinigera*, a Stratiomyiid. The burrows of the Hawaiian Crabronidae are usually formed in the ground; those of *Nesocrabro* have been found only therein. Others sometimes burrow in dead tree trunks, using, in harder woods, the borings of

[1] This species is now known to be American.

xylophagous beetles. *Hylocrabro* often makes its cells in soft rotten wood of such trees as the Kukui (*Aleurites*) or the Hau (Hibiscus). Some of the species visit flowers, e.g. *X. distinctus* and *X. mandibularis*, on the coasts of Oahu, Maui and other islands. In the mountains they are sometimes attracted numerously by the flowers of *Wikstroemia foetida*, and also those of *Metrosiderus*. In general, however, they are observed flying round and settling on the leaves of bushes and ferns in the sunshine. The females penetrate into dark shady places, so dark that they can hardly be seen, in search of prey. Some of the species of *Nesocrabro* emit a shrill noise, when on the wing, which much resembles the note of the Tachinids they are seeking.

The series of species represented in the islands exhibits a great variety in appearance, for some of them are much and conspicuously marked with yellow on all parts of the body, the yellow markings becoming reduced in others, until in *X. unicolor* we have an entirely black insect.

There is in the yellow-marked species much variety in the coloration, and the variation exhibited is often of an interesting character. Many years ago Smith described a Hawaiian *Crabro* as *C. distinctus*, from a specimen brought back by the old Beechey expedition in the early part of the last century. Smith's description, dealing mainly with colour, seemed to me to represent an insect so different from any Hawaiian Crabronid, that (in the absence of the specimen, which could not be found) I suspected a mistake had been made in the locality, and omitted the species from the Hawaiian list. *C. distinctus* is now well known to me, and is an extreme and rare variety of the species I called *C. notostictus*, which typically is a black insect, with small yellow thoracic markings. Intermediate specimens between the extremes are much commoner than typical *distinctus*. This brightly marked form has so far only been found at or near the coast, where the intermediate forms also occur, as well as the variety I called *notostictus*. In the mountains in the forest region the latter is predominant and intermediates are rarely met with. From these facts one might suspect that the hot dry climate of the coastal regions was productive of the conspicuously marked varieties. The following considerations make such an explanation improbable. In the genus *Nesocrabro* I described a species, gaily marked with yellow as *N. bidecoratus*, adding a remark to the effect that "In spite of its extremely distinct appearance I suspect it may prove to be a variety of the following" (*N. rubrocaudatus*). This now proves to be the case, intermediate varieties having been secured. The variation in this case is even more extreme than in the other, since typical *rubrocaudatus* is an entirely black-bodied insect, whereas the var. *notostictus* of *distinctus* has at least yellow thoracic markings. It is interesting to observe that the markings of the most highly coloured *N. rubrocaudatus* (var. *bidecoratus*) almost entirely resemble those of *Xenocrabro distinctus*. Looking at the localities, where these brightly marked varieties of *Nesocrabro* occur, we find that, far from living in hot and dry places, they are found in the wet woods near Kilauea (4000 ft.), in the still wetter district of Olaa and other localities of windward Hawaii. I think that these highly coloured varieties are 'reversions' to an ancestral style of coloration, and I believe this is borne out by an examination of the varieties of other Hawaiian species. In these there is a general tendency to blackness of coloration, some few retaining conspicuous yellow markings, while most have these reduced to inconspicuousness or they are entirely absent. *Xenocrabro hawaiiensis* and *fulvicrus*, *Oreocrabro abnormis* and *Hylocrabro tumidoventris*, species with normally black abdomen, all become spotted, as exceptional and sometimes very rare varieties. Species like *Nesocrabro stygius* and *daemonius*, with immaculate abdomen above, frequently retain yellow pigment spots beneath, where they are concealed from view. Generally speaking yellow markings, especially thoracic, are less easily lost in the female than in the male. The general blackness of the Hawaiian Crabronids, as now manifested, has I think been produced within the islands, and while some still retain more or less the colour of their ancestors, the majority have greatly departed therefrom, though many of them in exceptional individuals reproduce that coloration to a greater or less extent. Further, a study of the case cited of *Nesocrabro rubrocaudatus* and *Xenocrabro distinctus* lends strong confirmation to the community of descent that is suggested by the consideration of their structural characters. At least I find it difficult to understand how two species of these distinct genera can, under totally different conditions of climate and environment, produce remarkable colour varieties, totally dissimilar to their usual forms, yet almost identical with one another, unless they be reversions to a former style of coloration.

As in the bees, Hawaii is also the richest island in its Crabronidae, seven species occurring there, of which five are apparently endemic and one of the others is almost specifically distinct (*H. tumidoventris* var. *leucognathus*). Maui has six species, but only one is peculiar to it, whilst Molokai and Lanai have none endemic. Oahu, like Hawaii, has seven, but only three are peculiar to it. So far as yet discovered, however, it alone possesses the remarkable genus *Oreocrabro*. Kauai is poorest of all, with three species only, two of which, *Nesocrabro compactus* and *Xenocrabro monticola*, both occur on Oahu (the former also on Lanai and possibly other of the islands) and one only peculiar to itself, *X. affinis*. These statements are likely to need modification hereafter, but are based on the information accessible at the time of writing. They do not accord with the facts given in 1899, as might be expected.

No parasites are known to attack the Crabronidae of the islands, though it is quite likely that the Chalcidoid Encyrtidae may do so, nor did I find any specimens of them in the stomach of the many birds that I dissected. They have a peculiar odour, like members of their family in other countries.

Trypoxylonidae.—A family of little importance in our fauna, the Trypoxylonidae are represented by a recently introduced species of *Trypoxylon*, a native of China, occurring also, I believe, in tropical Queensland, and by three species of *Pison*, of the sub-family Pisoninae. One of these is of quite recent introduction, having become noticeable in Honolulu in 1903, but was not taken in 1900, when I collected a number of specimens of the other two species in gardens there. This recently introduced species now far outnumbers the other two combined, in Honolulu. It has different habits, in that, instead of nesting in burrows or cavities in woodwork, it forms mud-cells like those of *Sceliphron*, fixing these under ledges and on the walls of wooden houses, etc. The other two *Pison* are older introductions, both having occurred at Blackburn's period of collecting; both are apodemic and of Australasian origin. All the species, like *Trypoxylon*, store their nests with spiders. It is perhaps worthy of note that the *Trypoxylon* was introduced first into Hawaii, and not through the port of Honolulu, as has usually been the case with imported insects. It did not reach Oahu until some years after it had become widely spread and abundant on the large island.

SPHEGIDAE.—Represented only by the imported American *Sceliphron*, an universally distributed species in the islands, from the coast to 2000 ft. and sometimes higher elevations. It varies much in colour, as is the case in its native home. It is an injurious species, in that it disfigures the walls and ceilings of houses with its large masses of mud-cells. In the country these mud-cells are placed on rocks and trees, and whether in the houses or outside are frequently occupied by the introduced *Pison* or the endemic *Odynerus nigripennis*, more rarely by other species, as nests for their young. On Kauai *O. radula* also occupies the disused cells of *Sceliphron*.

EUMENIDAE.—This family is represented by a greater number of species than any other of the indigenous Hymenoptera, and all, to the number of 102, belong to the ubiquitous genus *Odynerus, sensu latiori*. From this interesting complex I have split off some small groups of species and considered them as distinct genera, as indeed they are, although they appear to be derivatives of the same stock, as the Hawaiian *Odynerus* proper. *Odynerus nigripennis* and its three allies are of different descent from that of all the others, and certainly are sprung from a quite different[1] ancestral immigrant. If the classification of the *Odynerus* of the world were not in a chaotic state, these four species would not be placed in the same genus as the others, and a number of genera or sub-genera, allied to one another, would also be formed for the dispersion of the bulk of the Hawaiian species. One might reasonably compare the Hawaiian series of *Odynerus* with that of the Nitidulidae in beetles. Though the known species are less numerous, and the specific characters much more distinct, they form a somewhat similar series of generic or sub-generic groups. The preciseness of the specific characters is itself an interesting fact, almost indeed unique in our Fauna, when large genera like *Odynerus* are in question. I think this distinctness of the species is quite real, and not at all due to the fact that the *Odynerus* have probably had more time given to their study than

[1] No doubt Asiatic; since allied Japanese species exist.

any other large genus of the Hawaiian insects. It is sufficiently proven by the fact that, except in a few special cases, the species have been accurately determined from my tables by those who either have had no previous knowledge of Hymenopterous, or even of any insect characters, after a very small amount of study. I do not think that any such result is possible with most other large Hawaiian genera (or groups of allied genera) such as are found in the Carabidae, Anobiidae or Nitidulidae for instance.

The *Odynerus nigripennis* group is probably of Asiatic origin, and I suspect is an ancient or primitive type, showing some affinity to the genus *Rhynchium*, in which the species above mentioned was originally placed by Holmgren.

Species of *Odynerus* are almost ubiquitous throughout the islands, though some of the densest and wettest boggy forests are absolutely devoid of them. At the same time a slight change in these, made by the incursion of cattle, is sufficient to allow of some species becoming established, where previously they could not exist. A minority of the species such as *O. nigripennis*, *O. obscure-punctatus* and others can occupy most diverse stations, from the coast to the region of frequent frosts in the high mountains. Some others thrive equally on the coast or in open areas in the forest region, or above the forest, but not in the thick forests. On Hawaii some of these pass from above the forest to the lowlands through the midst of the densest woods by means of the almost bare lava flows, by which the woods are intersected, but do not enter the forest on either side of the flow. Some, like *O. nigripennis*, are not affected by the diversity of station occupied, but others, like *O. scoriaceus*, have a tendency to local variation in colour, when subject to great difference of climate. Many of the species are true forest insects, some being confined to the drier and more open woods, others are only found amongst denser growths, with heavier rainfall. Some species occur high above the forest limit in the region of frequent frost, and of snow in winter time. Many are fond of frequenting the rocky mountain streams, not only for the purpose of drinking the water, but because they are enabled in dry weather to find there earth sufficiently moist for forming (in some species) or for closing their cells. At one time when camping on Maui at an elevation of about 9000 ft., where owing to the black lava sand and the bright cloudless sky the heat was intense by day, though below freezing point at night, it was interesting to watch two or more species of *Odynerus* visiting one of the water-holes, situated in so perfectly shaded a spot, that the water retained an icy coldness. After a copious drink of this water, each wasp would fall into a state of complete insensibility by the side of the water-hole, and as many as a score were observed in this torpid condition at the same time. After a considerable period, sensibility would return, and the wasps fly off without apparent injury.

In the forests these wasps are frequently taken on flowers, especially those of *Metrosiderus*, but they have been noticed on many other native trees. In general, however, they will be observed flying round foliage of trees and ferns, the females more slowly, while seeking for their prey, the males more wildly, in search of their females.

On the coast and lowlands they visit exactly the same plants, as I have mentioned in the case of the endemic bees (*Nesoprosopis*). In places where they breed some may be observed in the greatest abundance flying about rocks, especially where these are piled up to form rough walls, up and down which they are continually coursing.

Their choice of nesting places is very varied. Some (like *O. sociabilis*) burrow in the ground, especially in dry sandy lava. Others always form their burrows in dead tree trunks, and many (e.g. *O. obscure-punctatus*) are indifferent, breeding freely in posts and dead tree trunks, or in the porous cavities of lava rock, which latter appear to be the sole or chief nesting place of others. *O. nigripennis* and the allied *O. radula* occupy all sorts of nesting places, such as all those mentioned, and often the empty mud-cells of *Sceliphron*. These and others (e.g. *Nesodynerus rudolphi*, *O. montanus*, *hiloensis*, etc.) freely enter the verandahs and even the rooms of houses, where they make their cells in cracks or holes in furniture, in the cavities of bamboo, and other situations. *O. nigripennis* is so common about many houses, that it cannot fail to be often carried on ships with furniture, from one island to another. It has been taken as single specimens on Kauai, but whether it is really established there, I do not know. A few species, *Odynerus oahuensis* being one of these, have abnormal nesting habits, forming complete mud-cells, which are attached to the leaves of trees or to other objects. They are generally placed in sheltered situations, sometimes for example in a curled up leaf of *Pelea*, wherein a spider has made its nest; and as various other creatures, including young mollusca, seek the same shelter, we have several times found quite a collection of animals around the wasp's cell. On one occasion this wasp was watched bringing caterpillars to store an open cell, which was (with several already completed) suspended from the rootlets of a large fallen Ohia tree, bridging a small mountain stream. On other of the islands, where *O. oahuensis* does not occur, similar nests have been found, but the makers have not been identified.

The prey of Hawaiian Eumenidae, so far as is known, consists entirely of caterpillars. The number of these contained in a single cell varies according to the size of the species of wasp and according to that of the size of the caterpillars. A large variety of caterpillars are employed, and a single species of wasp is not only not constant to the use of one kind of caterpillar, but sometimes even mixes the species in a single cell.

On the whole it may be said that Pyralid and Microlepidopterous caterpillars are the favourite prey and that Geometridae are rarely utilized. It is most remarkable, seeing that the latter are occasionally taken (e.g. by *O. montanus*, *eucharis*, etc.), that this should occur so rarely, for the Geometrid caterpillars are so very numerous that they could be often obtained in any quantity. It is amusing to watch the common *O. nigripennis* hunting the caterpillars of *Omiodes*, which shelter themselves by spinning together the leaf or leaves of their food-plants. On Molokai a large 'wiliwili' tree (*Erythrina*) was the home of hundreds of the caterpillars of *O. monogona* and was constantly visited by the female of this wasp. She would keep running from one end to the other of the gallery of the caterpillar, as the latter retreated to and fro, until perhaps after dozens of these pursuits, the prey would drop down into the herbage below, to be at length found, stung into paralysis, and carried away to the cell. Several species of the wasps have been seen to carry off the grass-eating enemy of sugar-cane, *O. accepta*, and *O. epipseustes* preys on that of *O. continuatalis*. In fact no doubt almost any *Omiodes* caterpillar is acceptable to many of these wasps, for we have seen them visiting the plants of *Astelia* near the volcano at Kilauea in search of the species that feed on these. Of other Pyralid caterpillars various species of *Phlyctaenia*, *Pyrausta litorea*, and others, *Mecyna*, and the foreign *Hymenia recurvalis* are all well-known prey, so that it is probable that most Hawaiian species of this group fall victims on occasion. Of smaller moths the caterpillars of Tortricidae and Carposinidae are favourites.

It is a common sight to see *Nesodynerus rudolphi* and other species that are common on the lowlands, extracting the larvae of *Crocidosema plebeiana* from the flower-buds of *Sida*; in fact this Tortricid now furnishes an important food-supply of the larvae of various littoral and sub-littoral species of wasps. In the mountains *Eccoptocera foetorivorans* is a common prey. Besides these and other Tortricids, endemic and foreign, and various Carposinidae of the genus *Heterocrossa*, members of the Tineina are also preyed upon, e.g. the Gelechiid *Thyrcopa*, as well as introduced forms. With this range of choice in the nature of the prey, the number of caterpillars stored in a cell varies very much; over thirty of a Carposinid or small Tortricid (I failed to note which) were once found in one made by *O. oahuensis*.

In many localities at favourable seasons the number of individuals that are seen is extraordinary. On one occasion I visited a mountain gulch on Molokai nearly every day for three weeks and I estimated that in a length of a couple of miles (below the line of forest) the population of adult wasps in this length was at least one million. Five or six species were represented, but two or three were much more numerous than the others. I have noticed an almost similar abundance in other localities. As may readily be imagined, the economic value of these wasps is consequently very great. This is the more true, since they readily prey on the most injurious imported Tortricines, such as *Archips postvittanus* and other harmful caterpillars. It is probable that very few of the large number of species existing are really rare, though of some only a few specimens or even single examples have been taken. The Oahuan forms have been much studied, and the only one that has been found once only is *Nesodynerus optabilis*, and it must be remembered that the general appearance of this insect is exactly that of several of its commonest allies, so that it may readily be passed over. Excepting the littoral or sub-littoral species and the one just mentioned, every known Oahuan *Odynerus* has been found in the mountains within three or four miles of Honolulu itself, as one might say in one spot. Some, however, are of course much rarer than others, and their apparent rarity is increased by the fact that, like Aculeates in other countries, they are much rarer in some years than others, and further they appear at irregular times, so that a species may be abundant one year in March for instance, and another year in August, and in some years may hardly be seen at all. Consequently during any year unless one is constantly collecting at all seasons in a fixed locality one may easily miss the period of greatest abundance of any species or fail to find it at all. With experience and close attention in the field it is fairly easy to discriminate between species that are exactly alike superficially, owing to indescribable differences in appearance, often due to mode of flight and posture.

Only in exceptional cases do the Hawaiian Eumenidae exhibit important variation, and in very few cases is this more than of a trifling character, affecting the colour. There is, however, great variation in the size of individuals of a species, and this is due usually to the amount of food supplied to the larva, but sometimes to the fact of two eggs being laid in a single cell, so that the food supplied normally to one, has to nourish two larvae. To this constancy of structure is partly due the ease with which the many species can be discriminated. A common variation, which occurs again and again and in the most diverse species, is the occasional assumption of a feeble yellow band or traces of such a band on the first or first two abdominal segments in species which typically have an entirely black body. Examples of this are *Nesodynerus rudolphi*, *Odynerus venator*, *O. heterochromus*, to instance only species very widely separated in structure. Sometimes the yellow band appears only on the ventral surface. The phenomena are precisely identical with those observed in the Crabronidae, and I think are explicable in the same way. The blackness of so many Hawaiian Eumenids has been produced in the islands, and the abnormal individuals are reversions to a former general condition in colouring. These too, like the Crabronids, have retained in some species the original yellow-banded colouration.

The general tendency to blackness of the Hawaiian Aculeata as a whole is one of their most remarkable features. The blackness of these insects is increased by the dark colour of their wings, which in a large number of the species exhibits striking blue or purple reflections. The result of this is to produce a great superficial resemblance between many of the bees, wasps and fossorial wasps. Though similar phenomena appear in the Aculeates of other countries, I know no case quite comparable in extent with that observable in this fauna. We are not able to suggest any satisfactory explanation as to the cause of this widespread melanism. Were it universal it might certainly be considered protective, for the result is conspicuousness, but the allied species that lack the blackness thrive as well as those that possess it.

If we now return to the consideration of the Eumenidae by themselves, we again find most interesting facts in connection with their colouration. It may be said in brief that the Hawaiian *Odynerus* (s.l.) have become divided up into a number of colour groups, and that these are entirely different from groups based on structure and real affinity. As these colour groups occur on each island, and some of them indeed are only found on one of the islands, we may review the species on each island separately.

On Kauai are two colour groups, one of which contains only two known species.

GROUP I.

Insects with much red marking, wings shining fuscous, when spread.

O. blackburni and *soror*, allied species.

GROUP II.

Black insects with two conspicuous whitish or yellow bands on abdomen; wings dark and with conspicuous blue or purple reflections. Fourteen species of diverse structure. (Plate XVI, fig. 1.)

On Oahu are four colour groups, two of which may be said to be peculiar to this island.

GROUP I.

Black insects with dark wings, showing conspicuous blue or purple reflections.

O. nigripennis, epipseustes, erro, iopteryx, montanus, konanus, unicus. Nesodynerus optabilis, rudolphi. (Plate XVI, fig. 3.)

GROUP II.

Generally small species, black with shining fuscous wings, no blue reflections. In this group some species show feeble and variable pale abdominal bands, and others some red markings, apparently tending to disappearance and not conspicuous.

O. dubiosus, threnodes, pterophaennes, waianaeanus, paludicola, paranaias. Nesodynerus oblitus, acyanus. (Plate XVI, fig. 4.)

GROUP III.

Insects usually much marked with red, and the body with appressed fuscous tomentum. Wings to a large extent hyaline and with no blue reflections.

O. pseudochromus, pseudochromoides, leiodemas, homoeophanes, eucharis, oahuensis. (Plate XVI, fig. 2.)

GROUP IV.

Insects with usually two pale abdominal bands, the wings more or less infuscate and with blue reflections, body generally with pale tomentum.

O. xerophilus, nautarum, acoelogaster. Pseudoptero-cheilus relictus.

On Maui, Molokai, and Lanai, the fauna of each of which is largely the same, we have three groups.

GROUP I.

Identical with I on Oahu.

O. nigripennis, purpurifer, instabilis, ecostatus, laevisulcatus, camelinus, brevicostatus, aprepes, lanaiensis, konanus. Nesodynerus eupteryx, paractias. Pseudopterocheilus congruus. Chelodynerus chelifer.

Group II.

Identical with IV on Oahu.

O. molokaiensis, sociabilis, smithii, insubicola, nubicola nivicola.

Group III.

Insects with red thoracic or abdominal markings or both, the wings dark and with blue reflections.

O. frater, monas, cephalostictus, naiadum, tempe, dryas, potamophilus, microdemas, monobius, erythrostactes, montivagus, sandwichiensis, petrobius, deinogaster, homoeogaster. (Plate XVI, fig. 6.)

On Hawaii there is a general tendency of the above three Maui groups to become fused into one large group, all representing I. *O. obscure-punctatus* and *rubropustulatus* and one or two others may be recognized as obscure members of Group III. *O. newelli, sociabilis, scoriaceus,* represent II.

Speaking generally of these groups, I find that in the field, the members of each are easily enough distinguished. There are, as might be expected, some cases of species that are intermediate in appearance and which might be placed in either of two groups, but these are very few. On Kauai Group II stands out remarkably from all others, since nearly all the Kauai species belong to it, while it is only approached in appearance by a few species in Group IV on Oahu. The tendency of the species to become red-marked on the intermediate islands is very striking, nearly half the known species being so coloured.

Group IV on Oahu (= Group II of Maui, etc.) is not very clearly marked off from its Group I, when the insects are seen in flight, but as they usually have a characteristic grey or hoary appearance they may be kept apart, especially as they represent species mostly peculiar to open country or open spaces in forest country. When their representatives on Hawaii are considered, they become much less distinct from those representing Group I on that island.

Groups II and III on Oahu are peculiar to itself, the dull red markings, clear wings and body clothing of the former giving its members, dead or alive, an appearance unlike anything else, while the shining fuscous wings of the latter render that group equally unmistakeable.

In a few cases, isolated species have been found on islands, where they ill accord with the groups there represented, but one cannot overlook the probability of these being recent immigrants. Thus *O. frater*, a widely distributed species, has been found very rarely on Oahu, where it does not fit into any colour group, as it does on Maui, where it abounds. Excepting on Kauai, the Group I of Oahu is well represented on every island, besides tending to absorb all others on Hawaii, so that nearly half the known species of these wasps may be referred to it. The dominance of this group increases the blackness of our series, for it contains species almost or entirely black and with dark iridescent wings; and, when other groups of Hymenoptera are considered, is swelled by species of bees, of fossorial wasps, and even of parasitic Ichneumonoids.

It is clear that the colour phenomena exhibited by our Hawaiian Hymenoptera are similar to those seen in other countries (whether in the Hymenoptera or in other orders) where such colour groupings are explained as being associations of inedible species, which are easily recognized by predatory enemies from their similarity of colour. Whether this explanation is true in the Hawaiian case is, I think, very doubtful, though I do not doubt that a satisfactory explanation of this would also explain the others. The Australian Eumenidae, Prosopidae and Fossorial wasps furnish instances very similar to the Hawaiian, and in the same groups, as I have myself observed in the field, in that country. I feel considerable difficulty in the existence of four well-defined colour groups, the members of which more or less intermingle in locality on the small island of Oahu. Were each of these groups composed of members the most closely allied structurally to one another, the difficulty would appear less; but it is far otherwise, for the species of the distinct genus *Nesodynerus* are divided amongst Groups I and II, containing structurally diverse forms of *Odynerus*, and the remarkable Group III contains three quite different structural groups of the latter genus. On one occasion all the six members of this group were taken in the same spot and on the same day, and it is common to find two or three of the species flying in company, the number of individuals of each species varying according to place and season. In all the groups some of the species are always very much less numerous in individuals than others. Instead of becoming split up into four colour groups on Oahu alone, one would have supposed that it would have been more profitable and easy for one group only to have formed, as being more easily recognized. As it is, one certainly cannot say that one of these groups is more successful than another, for each contains extremely common and comparatively rare species. It may be noticed that, excepting two species (hardly to be reckoned as forest-insects, being probably recent derivatives from very similar forms on other islands) the Kauai wasps have practically become superficially all alike, and, as has been remarked, there is a strong tendency in the direction of a single colour group on Hawaii.

If we assume that these colour groups are formed by processes of natural selection and are indicative of inedibility, we are perplexed as to the immunity of insignificant forms, which do not attain notably iridescent wings or any markings, and yet fly around in company with these others and are equally or sometimes even more plentiful. For if these are successful, why should colour groups occur at all? It is fair, however, to say that the one instance in which an aculeate was taken from the stomach of a bird, was that of a diminutive male of *Nesomimesa*, one of the most inconspicuous forms, extracted from the thrush *Phaeornis lanaiensis*. It should be added that the writer collected series of nearly every land-bird on each island, and so was able to examine the stomach contents of a large number of birds in all, and the finding of a solitary

Mimesa only, would not tend to show the Hymenoptera, as a favourite food, in any shape or colour. As a matter of fact, an Aculeate Hymenopterous insect (with rare exceptions) is so unlike that of any other order by its general appearance in life, that one can hardly imagine any vertebrate enemy with sense enough to distinguish between colour groups of these and without the sense to distinguish the class as a whole. If colour groups in Hymenoptera have arisen as a mark of inedibility, the latter quality can I think have nothing to do with the possession of a sting.

At one time I supposed that the Hawaiian colour groups might be the result of the action of climatic differences, at least in so far as these groups were special to certain of the islands. This seems very doubtful, for we find the nearest approach to the colour group of wasps living in the forests of Kauai, in those living on the driest coasts of Oahu, and quite absent from its very similar forests. In fact a satisfactory explanation of the colour groups of Hawaiian Hymenoptera is wanting, and, when found, will no doubt explain some of the similar phenomena elsewhere.

It is interesting to trace the structurally allied forms on different islands and see how their superficial appearance is changed by entering different colour groups.

Odynerus eutretus of Hawaii is a black insect with dark blue-iridescent wings; on Maui it is represented by *O. homoeogaster*, a red-marked wasp; on Kauai by *O. mimus*, a conspicuously white-banded species. The *obscure-punctatus* group on Hawaii is replaced by the redder species *O. sandwichiensis* and its allies on the intermediate islands; on Oahu the blue iridescence of the wings is lost as well as all the red markings (*O. dubiosus* and allies), while on Kauai the red markings remain, but the wings are of a shining fuscous (*O. blackburni* and *soror*) as in the Oahuan allies. *Odynerus nigripennis*, ubiquitous over all the other islands, is replaced on Kauai by the banded *O. radula*.

From what has been said above, it appears that Hawaiian *Odynerus* have little to fear from vertebrate enemies, but in all localities (more or less), at times, a failure of food supply occurs. This is of course most marked in dry coastal districts, where, in some unusual seasons, vegetation never advances sufficiently, for a whole year or more, to furnish food for the caterpillars, which are the prey of these wasps. The same climatic causes, however, which retard the emergence of the Lepidoptera, until suitable weather returns for the growth of the food plant, cause the *Odynerus* to lie dormant in the larval stage and await the same conditions before pupation takes place. But for this, many of the littoral species would, no doubt, be quickly exterminated by occasional unusually dry seasons. The larvae of the *Odyneri* are attacked by a minute Mirine Encyrtid of the Chalcid series, and since such different species as *O. nigripennis*, *montanus* and *oahuensis* have been found to be destroyed, it is quite likely that many others are subject to its parasitism. This parasite was not noticed until 1901, when it was bred from *O. oahuensis* from the Makaha valley, but there is no good reason to suppose it to be of recent introduction, as up to that time few *Odynerus* had been bred.

It is now probably of universal distribution over the islands. Scores of individuals emerge from a single wasp-larva. Doubtless the anomalous, polyphagous Eulophid genus *Melittobia*, now present in the islands, will be found to attack many *Odynerus*. Though not noticed in Honolulu till 1903, in 1906 it was already found far in the forest on Hawaii at Kilauea. It is not yet certain whether it is an importation, but it probably is so. The wood-boring species of *Odynerus* and the builders of mud-cells (*O. oahuensis*) are parasitized also by *Eupelmus*, but whether those that burrow in the soil are similarly attacked is not known.

In spite of the fact that the island wasps are insects of strong powers of flight, and further that many form their nests in dead branches or trunks of trees, and even in some cases in those light-wooded trees, which frequently are conspicuous in the inter-island drift, yet they are quite remarkable for the large percentage of species peculiar to a single island, or, in the case of Maui, Molokai, and Lanai, to a group of adjoining islands.

Thus all the species known from Kauai are peculiar to it, excepting that isolated specimens of *O. nigripennis* have been once or twice found there, probably imported with furniture from Oahu. The latter species is ubiquitous throughout the other islands, and *O. frater* and *O. konanus*, though they are much less numerous than *nigripennis*, occur on all these. Apart from these three, Oahu has 25 species, all peculiar, except that one has once been recorded from Maui, perhaps wrongly. The three neighbouring islands Maui, Molokai, and Lanai, in addition to the three species above named, have two only (*Chelodynerus chelifer* and *O. sociabilis*) identical with Hawaiian species, leaving thirty peculiar to them.

Kauai, with all its species endemic, is far poorest in the number of known species, only seventeen having been described, Oahu the island nearest to it having no less than 28.

As the *Odynerus* (s.l.) are so easily collected, more accurate figures can be given as to the endemicity of the species of each island, than is possible with most Hawaiian insects. No doubt the figures are subject to alteration, but probably the percentage of endemicity will not be greatly affected. It is therefore worth while to tabulate the facts, as they exist according to my present information.

Island	Species found on	Species endemic on	Percentage of endemic
Kauai	17	17	100
Oahu	28	25	89
Maui, Molokai and Lanai	35	30	85
Hawaii	32	27	84

The close relationship between the three intermediate islands (here treated as one) is seen from the fact that the insignificant island of Lanai, with some ten species of *Odynerus*, has apparently nothing endemic, its most distinctive forms being only small colour varieties of those known from Maui or Molokai or both.

The percentage of endemicity of species on the islands, excluding Kauai, is, as shown above, extremely close, and, as more new forms are likely to be found on the other islands than on Oahu, this percentage may become still closer.

VESPIDAE.—The three species of *Polistes*, two of them introductions from China, viz. *P. hebraeus* and *P. macaensis*, and one from California, *P. aurifer*, are all very abundant insects. *P. macaensis* and *aurifer* were present in the islands more than thirty years ago, but *P. hebraeus* is of later introduction and was not generally distributed over the islands in 1892, nor did it reach Hawaii till some years later still. Although treated as varieties by most authors, *P. macaensis* and *hebraeus* are quite distinct by the different processes of the sixth ventral segment of the male abdomen. The *Polistes* are now nearly ubiquitous, from the coast to six thousand or more feet above the sea. On the central plateau of Hawaii I have noticed nests built in the bleached skulls of cattle and sheep, that are thickly spread in some parts of that desolate country. These wasps are beneficial in destroying numbers of harmful caterpillars, but are otherwise a nuisance. They are affected by the Stylopid parasite *Xenos*, and the Pyralid moth, *P. mauritialis*, breeds in the nests.

BETHYLIDAE.—The species of *Scleroderma* present feeble specific differences, so that the number recorded (10) is subject to change, for little is known as to their variability, etc. We have, however, noticed in bred examples of one species a very decided individual variation in the shape of the propodeum, an important character. Their habits are not well known. One or two species have been bred from dead wood, yielding various beetles (Anobiidae, Cioidae, Cerambycidae, Proterhinidae) and Tineid Lepidoptera mixed, and the possibility of other insects being represented, but failing to emerge, is, of course, great. It is, however, known that one or two of our species attack Microlepidoptera, so probably many have this habit. Male examples are very rarely met with in the field and not often bred, so that it is probable that *Scleroderma* like the apterous females of Dryinidae are often parthenogenetic.

Sierola differs greatly from *Scleroderma* in the fact that while individuals of the latter are not generally common, those of the first genus are quite the most plentiful of the parasitic Microhymenoptera. They are essentially forest insects, though one or two of them are occasionally found without the forest. Their habits are quite different from those of *Scleroderma*, for they are commonly seen running on the leaves of the 'Ki' (*Cordyline terminalis*), of *Pelea*, *Acacia koa* and many other trees and shrubs. They are parasitic on various caterpillars, but chiefly, I think, those of the Microlepidoptera (Tineina and Tortricina) from which I have occasionally bred specimens, but they also attack those of larger moths, for Swezey has bred *S. dichroma* from the caterpillar of *Omiodes asaphombra*. A former remark of mine that *Sierola* was parasitic on *Cioidae* is certainly incorrect, and it was, no doubt, *Scleroderma* and not

Sierola, that I bred from dead wood attacked by these and other Coleoptera. The species of *Sierola* are apparently somewhat variable and not always easily distinguished, and I rather suspect that they were more numerously represented in my collections, than is shown by Ashmead's discrimination of them.

These two genera embrace all the truly endemic Bethylidae, but in addition to these there have been described from the islands two semi-domestic species of *Holepyris*, as well as a species of *Sierolomorpha* (probably better referred to the Cosilidae). Of little importance, and at present undetermined, are a species of *Ateleopterus* parasitic on some of the insects (probably Coleopterous) that destroy stored seeds and grain, and a minute *Cephalonomia* that attacks the ubiquitous Scolytid, *Hypothenemus eruditus*.

Dryinidae.—This family is represented by a single species of the Australian genus *Echthrodelphax*, and one, or perhaps two, species of the widely spread genus *Pseudogonatopus*. The former is likely to be found elsewhere, being indeed extremely closely allied to an already known Australian species. It attacks Delphacid leaf-hoppers of various kinds, but apparently only on the lowlands or at low elevations, not being a true forest insect. The larval sac is placed beneath the lobe of wing or tegmen and a hopper frequently carries two of these parasites. In some cane-fields this parasite has reached extraordinary numbers at certain seasons, attacking the swarms of nymphs of the imported leaf-hopper of the sugar-cane. The larvae of *Echthrodelphax* like those of many other Dryinidae, are themselves attacked by chalcidoid parasites, which are almost certainly of foreign origin.

The Hawaiian representative of *Pseudogonatopus* is an anomalous representative of the genus and shows the most extraordinary variability in colour, some examples being nearly black, while others are quite pallid and in parts almost whitish. They vary both individually in one locality, and also very greatly, when taken in different localities. There are all sorts of intermediate conditions between the extremes. Ashmead recognized two species, but was doubtful as to their distinctness. *Labeo hawaiiensis* is the male of *Pseudogonatopus perkinsi*, the sexes having been bred several times. This Dryinid is found in the forests of all the islands, in very diverse localities, and attacking species of several genera of the endemic Asiracid leaf-hoppers. It is subject to the attacks of chalcid parasites of the Mirine group of the Encyrtidae, which attack its larvae, while still adherent to the leaf-hopper. Possibly owing to these parasites, the adults of *Pseudogonatopus* are less common than would be expected from the number of parasitized hoppers that are frequently seen. We have bred this insect from eggs laid parthenogenetically, although males appear to be constantly produced by the species.

Poneridae.—The exponents of the genus *Ponera* are no doubt introductions, excepting the forest-haunting *P. perkinsi*, which is rarely found on the lowlands. It lives in very small communities, usually of four or five to a dozen individuals, in woody places, where the ground is covered with dead leaves, or in more open places under logs or stones. It is often common under stones on the edges of the mountain streams. Throughout great areas of forest land, where the fauna is chiefly endemic, it is the sole representative of the Ants. It varies much in colour, and in some localities the majority of the individuals observed were conspicuously reddish.

The *Leptogenys* is possibly a natural immigrant, frequenting the lowlands and low mountain elevations. It nests both in tree trunks and dead wood, and in porous cavities of lava blocks. Its prey consists of Isopod Crustaceans, the remains of which are nearly always to be seen in heaps about or within the nest. It is fond of migrating from one spot to another, especially during the rainy season, and processions of these ants carrying their cocoons are a familiar sight in gardens in Honolulu. Sometimes we have found nearly every plant of a group of bananas to be occupied by colonies of the *Leptogenys*, these being disclosed when the leaves are stripped from the stem. No winged female has ever been found, though winged males are numerous. All the wingless examples are very similar, a slight difference in the length of the sting being the only distinction noticed between individuals. The winged male has, however, been taken in copula with one of these worker-like examples.

MYRMICIDAE.—This family is represented by a number of widely distributed or cosmopolitan forms of no interest in our fauna. I believe nearly all have been imported by man, and several new species have appeared since Prof. Forel's paper was published. Some of these ants are frequent inhabitants of houses, though they all flourish outside, e.g. *Pheidole megacephala*, *Monomorium vastator*, *M. floricola*, and *Cardiocondyla wroughtonii*, the latter breeding freely on some of the steamships plying between Australia and California, or Australia and Vancouver.

Cardiocondyla nuda is found in the mountains and on the coast alike. It is abundant in Honolulu, but was not collected by Mr Blackburn, so is probably of recent introduction. It varies a good deal in colour.

Solenopsis geminata and *Pheidole megacephala* have their nests infested by the Myrmecophilous cricket, *M. quadrispina*, and in that of the latter small Lepismidae are of frequent occurrence. Neither these nor the crickets, however, are confined to nests of these ants, for they equally infest those of some of the foreign Formicidae (*Prenolepis*).

Pheidole megacephala is the most abundant of all the foreign ants. In many parts it occupies not only the whole open country, but also the forests to a height of about 2000 ft. in the mountains. In open country it sometimes becomes established as high as 4000 ft., and may be numerous at three thousand. Usually, where forests are dense, it ceases to range above about 1200 to 1500 ft. of elevation, while in its range, no matter how fine or how dense the forest may be, the endemic fauna, save for a few forms, that can resist, or are tolerated by the ants, is entirely exterminated. This native fauna, especially of beetles, appears as if by magic, the moment the limit of range of *Pheidole* is reached. In some places on the coast there are localities so dry and hot that *Pheidole* cannot occupy them permanently, and here a remnant of a lowland endemic fauna persists, unsuitable as are the conditions for insects in general. Of the native insects that are attacked by *Pheidole*, the Aculeate Hymenoptera are the least injured. Even in the case of large Crabronids and wasps of the genus *Odynerus* it is common enough to find specimens with one or more workers of *Pheidole*, or with the great head of the soldier-form attached to their legs or antennae, and we have noticed instances where these strong insects have been entirely overcome by their assailants.

DOLICHODERIDAE.—Represented only by the introduced American form of *Tapinoma melanocephalum*. This small ant flourishes best in dry hot localities on the lowlands or lower mountain slopes. It is very common.

FORMICIDAE.—The three species of *Prenolepis* and one *Camponotus*, that represent this family, are no doubt introductions and of no interest. The latter is to a large extent domestic, breeding in incredible numbers in the walls of the wooden houses in Honolulu. In some of these (even in houses only a few years old) this *Camponotus* (*C. maculatus*) is an intolerable nuisance. Swarming takes place on dark still nights, when all forms of the ants issue from their nests, covering the floors, walls and tables and even entering the beds. Though partial to houses, *C. maculatus* thrives well enough in the open, but only on the lowlands, or at low elevations in the mountains. *Prenolepis sharpii* was imported in a box of plants from Hong Kong, the earth, in which the plants were sent, containing a great nest of this species, including hundreds of winged males and females. It quickly became naturalized.

CERAPHRONIDAE.—There are no endemic species in this family, but three species of *Ceraphron*, two of which have been described, are known to occur. All are found in Honolulu itself, and will no doubt become general in distribution. *Ceraphron abnormis* appeared in 1903 and subsequently became abundant. It is a North American species and has been swept from grass in California. Swezey has made known its habits, it being a hyperparasite of leaf-hoppers, through the Dryinidae, *Echthrodelphax* and *Haplogonatopus*.

SCELIONIDAE.—There are several species of the ubiquitous genus *Telenomus*, some being no doubt introductions, e.g. two that have been bred from the eggs of the foreign bug, *Rhopalus hyalinus*. Others, however, have occurred in the forest region and their habits are uncertain. One rather remarkable species is found numerously on Hawaii in company with Asiracid hoppers, a small Capsid and *Reduviolus*, and is likely to be parasitic in the eggs of one of these Hemipterous insects.

A species of *Baeus* is found in wet places in the mountains, and no doubt will be found to be parasitic in spiders' eggs, and could be bred from these. We have only found single specimens of this minute insect, and they are generally lost from being mixed up in the killing bottle with larger forms.

Two allied genera *Pseudobaeus* and *Dyscritobaeus* are described for insects occurring in gardens in Honolulu, where they frequent foreign grasses in company with apodemic insects, such as *Reduviolus capsiformis*, *Orthoea vincta*, etc., but their habits are not known. They are most likely parasitic in the eggs of some of the insects occurring with them. With these also occurs a species of *Opisthacantha*, doubtless an imported species, now widely distributed. It is probably parasitic in eggs of grass-frequenting Hemiptera, as it has been noticed in numbers in places too dry for the occurrence of Orthoptera, but where *Reduviolus*, *Orthoea* and *Nesomartis* are found. Two species of *Caloteleia* are also recent importations, one first appeared in 1903, the other still later, in Honolulu. The genus *Anteris*, on the other hand, though itself apodemic, contains only endemic species, true forest insects, the hosts of which are not known. There are six described species, all excessively closely allied, and perhaps not all truly distinct. It is possible that they parasitize the eggs of the Locustids of the genus *Brachymetopa*, some of the species of which are unaccountably rare.

Platygasteridae.—A single species of *Inostemma*, no doubt introduced recently, is the sole representative known of the above family. It has occurred only in the vicinity of Honolulu.

Proctotrypidae.—A single species of *Proctotrypes* is common on the higher mountains of Maui and Molokai[1]. We have bred it from malodorous decaying fern-stems, infested by the larvae of *Drosophila*, and other Diptera. It also frequents *Astelia veratroides*, at the base of the leaves of which decaying vegetable matter accumulates, and forms a breeding ground for small flies.

Diapriidae.—The species of *Phaenopria* are endemic forest insects, and the endemic genera, *Zacranium* and *Platymischoides*, seem to be derivatives of these. In fact, I have described species of Ashmead's last-named genus, as simply flightless forms of *Phaenopria*, considering the two hardly generically distinct. The species are no doubt numerous in the islands, closely allied, and difficult to distinguish, and some of them show considerable individual differences in the shape of the head. All (except *Zacranium*, the habits of which are unknown) are parasitic on 'vinegar-flies' of the genus *Drosophila*, from which several have been bred. Owing to sexual differences, and the fact that closely allied species live in company, I have not been able to associate

[1] It is also found on the other islands.

the males with their proper females, and until this can be done the former are better left undescribed.

Two species of *Diapria* are of comparatively recent introduction, found in gardens in Honolulu, and becoming more widely distributed. One of these is a common parasite of an imported species of *Drosophila*.

Figitidae.—The parasitic Cynipoids are represented only by members of the subfamily Eucoilinae, and, adopting the views of Kieffer as to their definition, by only two genera. Ashmead, however, recognized six genera in the nine endemic species, that he described. I have increased these to twenty-three, without describing males. The latter cannot without special observations be referred to the other sex. All these Hawaiian forms appear to be related to one another, in the genera, in which they are placed, viz. in *Cothonaspis* and *Eucoila*. Even the distinctions between these genera seem to be broken down to some extent by some of the Hawaiian species. Some species in both genera have been bred, and they are parasitic on the larvae of small flies of the genus *Drosophila*. Some, like *Proctotrypes*, are found at the base of leaves of *Astelia*, where decaying vegetable matter collects and small flies breed. Some frequent bushes or small trees such as *Myoporum*, flying round the foliage, and it is possible that they will be found to parasitize small Diptera, the larvae of which feed in fruits and berries of various native trees. In general, these parasites prefer damp shady places in the forest, where is a dense undergrowth of fern. When largely collected, I anticipate that great difficulty will be found in distinguishing the island species, which may be very numerous. In addition to the endemic species, a single *Eucoilidea* is found on the lowlands in Honolulu, and elsewhere. It is parasitic on small leaf-mining flies of the genus *Agromyza* and certainly introduced.

Mymaridae.—Apart from introduced species of *Alaptus*, *Anagrus* and *Leimacis*, of no interest in our fauna, the genus *Polynema* alone represents the Mymaridae. There are, doubtless, many species, fifteen having been already recognized. So far as is known these Hawaiian *Polynema* parasitize the eggs of Hemiptera only, both the Heteroptera (*Reduviolus*) and the Homoptera (*Nesophrosyne*, several species, in the Tetigoniidae, and *Nesodryas* and *Nesosydne* in the Asiracidae). It is probable, however, that they have other hosts, since we have bred a large species from branches of trees, killed by the borings of one of the endemic Tortricid caterpillars of the genus *Archips*. Eggs of the Hemiptera above specified would not be very likely to occur in such a situation.

Chalcididae.—Four species only of this family occur and one of these, *Chalcis obscurata*, has been imported for economic reasons. It is now one of the most abundant insects in our islands, and serves to conceal the presence of *C. polynesialis*, which still occurs, but is rarely noticed amongst the swarms of its economically important congener. *C. polynesiale*, though occurring in Blackburn's period of collecting, is almost sure to prove an introduction, and recently a third species (though of another genus, *Hockeria*) has become perfectly naturalized on Oahu. *Chalcis obscurata* is interesting, otherwise than economically, owing to the fact that it frequently attacks insects already parasitized by some other insect. Consequently it has even been bred from the pupa of other parasitic Hymenoptera (e.g. the Ichneumonid *Echthromorpha maculipennis*) and Tachinid flies. It seems deficient in its instincts, for we have observed one ovipositing in the pupa (concealed of course between the layers of palm leaf) of *Omiodes blackburni*, when examination showed that the pupa had previously been squashed flat, and was quite dead and dry. Nevertheless in productiveness it is one of the most successful of insects. *Epitranus lacteipennis*, discovered by Mr Blackburn, still occurs on Oahu, but is rarely met with. Its habits are not known, nor has it been found except in the neighbourhood of Honolulu.

EURYTOMIDAE.—Represented only by species of *Eurytoma* and one or two of *Isosoma*, all of recent introduction. The former is hyperparasitic, attacking Braconids, especially *Bracon omiodivorus*, a common parasite of Pyralid caterpillars, and less frequently *Apanteles*. Its presence was not noted until 1903, when it was already numerous. It is very widely distributed, and in Honolulu we have found it on the dry coast of Waikiki, as a hyperparasite of *Omiodes blackburni*, as also in the wet valley of Nuuanu. It is common in some of the cane-fields of Hawaii, where *Omiodes accepta* is an abundant host of *Bracon*, and on one occasion at Pahala we observed countless numbers of the males flying round and running on the leaves of cucurbitaceous plants, growing in waste places. The 'joint-worms' or larvae of species of *Isosoma* are attached entirely to imported grasses, and are abundant in Honolulu and no doubt elsewhere. There appear to be two species, which are parasitized by an Eupelmine Encyrtid, and I think also by a Pteromalid.

MISCOGASTERIDAE.—This family is chiefly represented by a number of species of *Toxeuma* all endemic, and by the endemic genera *Neolelaps* and *Mesolelaps*, the former with several species, though only two have been described. These are all true forest insects and usually sparingly met with. Though we have bred one or two species, their habits are not certainly known. They appear to be associated with the caterpillars of microlepidoptera or small beetles that attack stems or fruits of native trees. The species of *Toxeuma* are likely to prove very difficult to distinguish. They are bred from twigs containing small beetle larvae, *Proterhinus, Cis*, etc.

ENCYRTIDAE.—The sub-family Eupelminae is chiefly represented by about fifty described species of the ubiquitous genus *Eupelmus*, forming a remarkable series, diverse in structure and in habits. The specific value of a good many of those that I have described is uncertain, since some of them are variable and the species are no doubt very difficult to determine. It is impossible to correlate the sexes, unless a species has been bred. Most of the known species are found in the mountain forests, but some have occurred on the lowlands and it is possible that some of these are not endemic. Some are egg-parasites of various orders of insects, e.g. *E. axestops* (?) bred from eggs of the Locustid *Brachymetopa*, and *E. rhyncogoni* from those of the Otiorhynchine weevil, *Rhyncogonus*. Others attack larvae of various Coleoptera, or of Neuroptera of the Hemerobiid family (*Anomalochrysa*). Some are frequent parasites of several of the larger bees included in the genus *Nesoprosopis*, and also of certain *Odynerus*, while some are parasitic on Diptera and others of Lepidopterous larvae, both case-bearing and others. The genus *Solindenia*, described as peculiar to the islands, is a common insect, and will almost certainly be found elsewhere. It is parasitic in the egg capsules of cockroaches of the genus *Phyllodromia* and is found to attack foreign species, as well as the native *P. obtusata*. The single *Anastatus* is quite certainly an introduction, and though now widely spread, is a common garden insect in Honolulu, where it parasitizes the eggs of the introduced Locustid *Elimaea appendiculata*. The habits of the one described *Eupelminus* are not known.

Of the Encyrtinae, *Encyrtus fuscus*, one of the most abundant insects in parts of Australia, as we have found it, is no less common in the islands, being introduced and parasitic on various species of scale-insects of the genus *Lecanium*, also introduced.

The members of the tribe Mirini include some common parasites of foreign scale-insects, *Microterys flavus* e.g., and *Blepyrus insularis* (= *B. marsdeni* How.) which are clearly introduced. Others, however, are likely to prove endemic, e.g. the parasites of the Dryinid leaf-hopper parasite, *Pseudogonatopus*, and a species, which infests the larvae of various kinds of wasps of the genus *Odynerus*. *Aphidencyrtus* on Aphidae is of course introduced, as also is a species, for which the late Dr Ashmead proposed to characterize a new genus, *Amicroterys*, common in gardens in Honolulu, where it parasitizes an abundant scale-insect of *Cynodon dactylon*.

The habits of several other species are at present unknown.

The tribe Ectromini includes six species of the genus *Anagyrus* (?) described by myself, but whether these are all really good species is doubtful. Their habits are not known, and until these are ascertained, I feel doubts as to the endemicity of the species. They occur near the coast, as well as in the mountains. Should they prove to be parasites of foreign Coccidae, we may be sure that they are themselves foreign and either have been introduced accidentally with their hosts, or in some cases, possibly, for economic reasons by Koebele. He, as I know positively, attempted to introduce *Anagyrus* from China and Japan.

Pteromalidae.—The great complex of genera here included, is almost unrepresented by endemic species, for of the very few known to exist in the islands, only one, *Spalangia lanaiensis* has any claim to be considered indigenous. This is a true forest insect and has been bred from more than one of the smaller endemic species of *Drosophila*. Two other species of *Spalangia* are known, but they are clearly importations, parasitizing the puparia of various common introduced flies, the larvae of which feed in cow dung or other excrement. One of these was identified as *S. hirta*, and in fact it is practically identical with specimens of a *Spalangia* from Europe and China, and hardly different from a Mexican form. Still it does not agree with Haliday's description in the length of its antennal joints, and so we have considered it to be distinct from *S. hirta*.

One or two species of *Pteromalus*, one of which has been bred from a foreign Tortricid, are not likely to prove endemic, and one or two of the genus *Pachyneuron* or allied forms connected with foreign Diptera, are likewise introductions.

The scale-insect parasite *Tomocera californica* is an introduction from Australia, where we have seen it, and other species of the genus, in abundance. It was found commonly by Mr Blackburn, and described as a new genus *Moranila*. Although it bears the specific name *californica* it is of course an introduced species in California, as into the islands. Owing to other parasites and predators, introduced to destroy *Lecanium*, the *Tomocera* is now far less plentiful than it was some fifteen years ago.

EULOPHIDAE.—In this family the sub-families Aphelininae and Tetrastichinae, the former with numerous species parasitic on introduced Aphidae, Coccidae and Aleyrodidae, are all probably introduced, the only species that are at all likely to prove endemic are in the Tetrastichinae, viz. the polyphagous *Melittobia* and an undescribed forest-frequenting species of uncertain genus and habits. I believe, however, that these are also introductions, like *Tetrastichus hagenowii*, which is hyperparasitic in cockroach egg-cases, wherein it attacks *Evania*. *Paraphelinus xiphidii* is an Aphelinine of rather ordinary structure, but most interesting from its habits. It parasitizes the eggs of the common imported Locustid, *Xiphidium varipenne*, and also is a hyperparasite of leaf-hoppers, breeding in the cocoons of the Dryinid *Haplogonatopus*, as recorded by Swezey. This diversity of habits in a member of a group so constant otherwise in the limits of its parasitism, is of great interest.

The other members of the Eulophidae must, in the present state of our knowledge, be considered specifically endemic, though none of the genera are peculiar to the islands. They include in the Entedoninae the genera *Astichus* and *Omphale*; in the Elachistinae *Ophelinus*; and in the Eulophinae *Hemiptarsenus*, *Necremnus*, *Sympiesis* and *Eulophus*. In some of these genera several new species (at present undescribed) are known, but they preserve very badly and offer small attraction to the collector or describer. Many of them are familiar parasites of leaf-mining microlepidoptera and they are commonly bred from mines of *Philodoria* in leaves of *Pipturus*, *Metrosiderus*, etc. and from the common circular mines that so often disfigure the foliage of *Pelea*.

The species of *Omphale* is (if indeed there be only one) remarkable for its extreme variability in size, colour and sculpture. It attacks various leaf-mining caterpillars, those of *Gracilaria* being commonly parasitized on the lowlands, and those of *Philodoria* in the mountains. It is, however, known to attack species other than leaf-miners, e.g. various microlepidoptera, whose larvae live in fruits, etc.

Trichogrammidae.—It is doubtful whether there are any species of this family endemic, and highly improbable that any of those hitherto discovered are other than introduced. *Westwoodella hilaris* is found on foreign grasses in gardens in Honolulu and itself is clearly foreign. Of *Pentarthron* (which appears to be a synonym of *Trichogramma*) several species occur. *P. flavum* is a parasite of lepidopterous eggs and is often seen running on foliage, as also is *P. semifumatum*. *P. flavum* may be no more than the widely distributed *Trichogramma pretiosa*, which attacks many kinds of insect eggs. The eggs of *Anomalochrysa* are parasitized by the same genus, possibly by the same *T. pretiosa* (or *P. flavum*) or by a variety of this. Eggs of the introduced Locustid, *Elimaea appendiculata*, are attacked by another species, apparently undescribed, many individuals of the parasites emerging from a single egg of the cricket.

Evaniidae.—One of the two species of *Evania*, both of which are very common insects on the lowlands and lower mountain slopes, is of wide distribution outside the islands, being carried in ships; the other is only known at present from the islands, but is certainly foreign, and will be found elsewhere. It is, like the common *E. appendigaster*, a parasite of foreign cockroaches, not of the one endemic *Phyllodromia*. Both these *Evania* are attacked by the hyperparasitic *Tetrastichus hagenowii*.

Ichneumonidae.—Ichneumoninae are entirely wanting, except for a species of *Ichneumon*, introduced for economic reasons by Koebele, and the Cryptinae have three species of *Hemiteles*, as recognized by Ashmead, but all the Hawaiian specimens of the genus that I have seen belong to one variable species, presumably *Hemiteles tenellus*, a common parasite of *Chrysopa*, introduced from N. America. The Pimplinae are more interesting, for we find here an endemic genus, *Glyptogastra*, with two described species. The habits are not certainly known, but we have found one species flying about twigs bored by caterpillars of a large species of *Archips*, the pupae of which it may parasitize. *Echthromorpha maculipennis* is remarkable for its great variability in details of colouration, size and otherwise. It is doubtful whether all the Hawaiian specimens are not referable to one, though extreme variations might be described as forming several distinct species. This parasite is almost ubiquitous, being found in gardens in Honolulu and throughout the mountains, and in cultivated places on all the islands. It is often extremely numerous in individuals and parasitizes many very different kinds of Lepidoptera. Chrysalides of *Pyrameis tammeamea*, found in the forests, more often produce this parasite than the butterfly, in my experience. All pupae that are moderately exposed, such as those spun up in cocoons on leaves of trees, or between layers of leaf are sorely attacked by this parasite. *Plusia*, *Omiodes* and other Pyralidina, as well as the *Pyrameis*, are favourite hosts. It abounds in localities with excessive rainfall. *Pimpla hawaiiensis* is an apodemic species, which we have bred from a Mexican Tortricid. In the islands it is often bred from pupae of introduced Tortricina, as well as from native Pyralidina. It is very abundant.

The Tryphoninae are represented only by two widely distributed European species, both of course introduced, viz. *Metacoelus femoralis*, which seems barely to maintain its foothold, and *Bassus laetatorius*, the too abundant parasite of the introduced Australian Syrphid fly, *Xanthogramma grandicornis*.

The sub-family Ophioninae is by far the most important section of the Hawaiian Ichneumons. At the present time I recognize forty species of this group distributed in eleven genera, *Idecthis* and *Lathrostizus* being considered synonymous. One species of *Limnerium* is certainly foreign, being a common insect in cabbage gardens, where it parasitizes *Plutella cruciferarum*. The single *Idecthis* and *Lathrostizus* are also subject to great suspicion, as introductions, and also the *Pristomerus*, though at present they have not been identified from other countries. The bulk of the species, as will be seen, if we subtract these dubious natives, belong to the true Ophionines and the genus *Atrometus* of the Anomalines. Of the former the genera *Banchogastra*, *Pycnophion* and *Pleuroneurophion* are endemic, the two former indeed are amongst the most remarkable of their group. Most of the species of the Ophionines are absorbed in the genus *Enicospilus*. These are remarkable for the variability of important characters, as well as superficial ones, so that sometimes individuals are met with, which have lost the generic distinctions. In consequence, the status of the species is by no means settled, and the more the specimens are collected the more difficult is it to define the specific characters. One striking character, in which variation is shown in some species, is the transverse propodeal carina, while in others it appears to be quite constant. In some variable species it may be present and distinct or largely effaced, according to the individual. In some species the carina is normally well-developed in the female and wanting in the male, as in the case of *Enicospilus kaalae*, but in this species a proportion of the males have the carina strongly developed like that of the female. The spots in the discocubital cell also are subject to variation and may be distinct or effaced in different individuals of a single species. In some species they appear to be normally or always absent, decharacterizing the genus.

Many of the Hawaiian Ophionines may be seen flying freely in the forests in the day time, especially in places where ferns grow freely. They are also on the wing at night and are sometimes attracted to lights. Many are of social habits and crowd together in numbers, when at rest. We have seen dozens of examples of a species resting beneath one or two adjoining leaves of a large-leafed tree, so thickly indeed as to hide the surface. At other times they form great flocks in dead hanging fern fronds. These assemblies are sometimes all of the male sex, but sometimes mixed. Sometimes too the species are mixed in these assemblies. So far as we know only *Enicospilus* and *Pleuroneurophion* congregate in this way, the others being more solitary. Individuals of many of the species are very numerous. Even within a mile from Honolulu, on the fore hills, we have seen hundreds of examples of *Enicospilus molokaiensis* (? *Ophion lineatus* Cam.) flying about together in the sunshine, in an area of a few square yards. Geometers, Pyralids and Noctuids have all been found parasitized by *Enicospilus*, but though many members of the large genus *Scotorythra* (Geometridae) have been bred, they have very rarely been found to be attacked. Consequently I suspect that the caterpillars of the genus *Agrotis*, when occurring in localities, where the parasites are common, will be found more subject to their attack. The smaller *Athyreodon* attacks Pyraustid caterpillars of the genus *Phlyctaenia*.

Limnerium blackburni is one of the commonest Hawaiian insects, of universal distribution in the islands, and exhibiting slight variation in superficial characters. It attacks so many of the Pyralidina that it is useless to specify particular species parasitized, but *Omiodes* and *Phlyctaenia* are favourite hosts. We have known *Phlyctaenia stellata*, for instance, to suffer from its parasitism to such an extent that about 90 per cent of the caterpillars were destroyed. It also attacks *Scoparia* as well as Tortricina and Tineina, and parasitizes foreign as well as endemic caterpillars, being notably polyphagous. *Pristomerus*, I think, has but one variable species, not two, as described by me. My original specimens coming from different islands and differing greatly in superficial appearance were not recognized as belonging to one species. It parasitizes the caterpillars of various Pyralidina, while *Lathrostizus* is often parasitic on some domestic caterpillars, probably Phycitidae. The small Anomalines of the genus *Atrometus* are met with much more sparingly than the Ophionines. They are found only in the forests, flying over ferns, or round bushes, especially *Myrsine*, *Pelea*, etc. They have been bred from the larvae of endemic Tineina or Tortricina feeding in shoots of native trees.

ALYSIIDAE.—*Aphaereta muscae* is an introduction from N. America, and a common parasite of various foreign flies, the larvae of which live in cow dung. *Aspilota* has been bred from similar Dipterous insects and is also probably foreign. There are no certainly endemic Alysiids known.

BRACONIDAE.—The Aphidiinae are represented by a single introduced species, which destroys the cabbage Aphis, the Euphorinae by '*Centistes*' *americana*, a common parasite of the imported ladybirds *Neda abdominalis* and *Coelophora inaequalis*. The

Cheloninae have three species; *Chelonus blackburni*, occurring also in Australia, is a very common parasite of various foreign Lepidoptera of different families, sometimes attacking native species also. *Phanerotoma hawaiiensis*, which first appeared between 1897 and 1900, and is now common, was probably introduced by Koebele from Japan, while quite recently another species has appeared in Honolulu. The Agathidiinae are represented only by *Microdus hawaiicola*, not a true forest insect, but which, being polyphagous, has been bred from caterpillars of foreign Tineina of various kinds, the imported cotton-boll Gelechiid (*Gelechia gossypiella*) being one of these. It does, however, attack endemic Tineina, e.g. *Hyposmocoma*. The Microgasterinae contain several species of the ubiquitous genus *Apanteles* (s.l.), two at least of which are known to be parasites of apodemic Tineina and Tortricina. No doubt all are introductions. The Braconinae, quite unrepresented in Blackburn's collection, now have several species of *Bracon*, one (*B. omiodivorum*) being a most abundant parasite of the Pyraustid caterpillars of the genus *Omiodes*. It was introduced, I believe, by Koebele and has spread and increased greatly during recent years, having now entered the mountain forests. Another species is an abundant parasite of a Trypetid fly of the genus *Tephritis*. A species of *Habrobracon* is often found in houses, being parasitic on caterpillars that attack articles of food. It is also common enough in the open, where it frequently parasitizes Phycitidae that infest the pods of the algaroba tree, *Prosopis*. *Ischiogonus palliatus* of the Rhogadinae was discovered by Blackburn, and is probably now more abundant than formerly, attacking larvae of Longicorn beetles, whether native or foreign. It is also found in Fiji, and was no doubt introduced into the islands. It exhibits a good deal of variation, this apparently depending to some extent on the species of its host. It appears to attack some Curculionidae as well as Cerambycidae. A second species has more recently been introduced and freely parasitizes *Clytarlus* and *Plagithmysus*, the endemic Longicorns, as well as some imported genera. The insect described as *Hormius* (?) *peregrinus*[1] is parasitic on xylophagous beetles of the family Bostrychidae, and is of recent introduction, being sometimes found commonly in Honolulu. This insect is no true *Hormius* and seems to be related to the Helconinae, and perhaps should be transferred to that group. It also occurs in Fiji. In the Spathiinae, *Ecphylopsis nigra*, a minute flightless insect, is no doubt endemic, and is the only known Braconid that has any claim to be considered so. It is known to me from all the islands (except Lanai) and is a true forest insect. It is bred from dead wood containing larvae of minute beetles, e.g. *Proterhinus*. A minute species of *Spathius* has once occurred in Honolulu and is certainly introduced. It was found flying about some boards, that were infested by countless individuals of a probably foreign *Dryophthorus*. One or two other species of Braconidae of recent introduction are not included in this account, as they have not yet been examined.

[1] This is probably *Euscelinus* of Westwood.

Review of the Coleoptera.

Forty-three (or if the Lyctidae be considered as a group in the Bostrychidae 42) of the 85 families of Coleoptera, as enumerated by Sharp in the *Cambridge Natural History*, have representatives in the Hawaiian islands.

Of these families, however, 26 are, as I believe on various kinds of evidence, entirely foreign to the natural fauna, being introductions by man, and four others (Hydrophilidae, Dytiscidae, Anthicidae and Coccinellidae) are represented by either imported or naturally immigrant species, likely to be found elsewhere. Excluding these, the real Hawaiian fauna of beetles represents only 17 families.

The total number of species described or enumerated[1] is 1288, these being included in 229 genera.

The 26 families above mentioned as being foreign to the natural fauna are represented by only 71 species and these are scattered in no less than 57 genera. However, as many of the families belonging to the true native fauna are represented not only by species and genera that are really native, but also by introduced ones, it is necessary to analyse these 17 families in order to understand the true nature of the fauna. Thus in the Cerambycidae 10 of the species, each belonging to a different genus, are importations by man, leaving five genera with 52 species native.

The Curculionidae have 14 foreign species (one or two, however, being natural immigrants) in nine genera; 132 species in 12 genera are of the true fauna. The genus *Pentarthrum* contains imported and a native species.

The Scolytidae have seven foreign species in three genera; 17 apparently native species of *Xyleborus*, which also contains foreign forms.

There are 136 endemic species of Proterhinidae, at present all included in the genus *Proterhinus*.

The Cistelidae are represented only by endemic forms, the two genera containing 12 species.

The Tenebrionidae have eight foreign species in six genera; one genus with a single species is possibly endemic, but will quite probably be found elsewhere.

The Cioidae have three probably foreign species in one genus, leaving 39 truly endemic forms in two genera.

The Anobiidae have four foreign species in three genera, and 134 endemic in the same number.

The Elateridae have five foreign species in five genera; the native fauna has also five genera with 76 species.

The Lucanidae have one genus endemic, with seven species.

[1] This does not include a number of species introduced for economic reasons, nor a number of recent casual introductions, now well established.

The Dermestidae have three foreign genera with five species; three genera with 21 species are endemic.

The Cucujidae have 10 foreign species in seven genera; there are 10 native species in two genera.

The Colydiidae are represented by three foreign species, each in a different genus, and a single endemic genus with one species.

The Nitidulidae have six foreign species in two genera, and 136 native ones in 13 genera.

The Histeridae have five foreign species in three genera, and 34 native in a single genus.

The Staphylinidae have 24 foreign forms included in 16 genera, and 95 true members of the fauna in 13 genera.

The Carabidae have six probably foreign forms in three genera, and 204 endemic species in 36 genera.

If we remove from the above families the introduced species and the few natural immigrants, either known to be found or likely to occur elsewhere, and add these to the 71 species found in families that contain only foreign forms, we find that the foreign element consists of 181 species distributed in 131 genera. The truly native fauna on the other hand consists of 1107 species distributed in 102 genera. Thus in the foreign element these genera contain rather less than 1·4 species to each genus on the average, while in the other group the species are 10·8 to the genus. Perhaps, however, the few certain natural immigrants should be rather added to the truly native species, but as these immigrants number in all less than a dozen, the striking contrast between the natural and imported coleopterous fauna would be only slightly changed thereby.

We must also notice an essential difference between the native genera and the imported ones. Thus the latter are rarely or never closely related one to another, while many of the former are formed for species which are clearly closely related to other endemic species, so that the genera are frequently very closely allied to one another, and in fact difficult to distinguish by trenchant characters. For instance, many of the genera of Carabidae are excessively closely allied and the distinguishing characters are not always constant. The three allied genera of Cerambycidae, *Plagithmysus*, *Callithmysus* and *Clytarlus*, contain species that show characters connecting one with another.

In some of the genera the species are remarkably restricted in their range over the islands. This is notably the case with the Cerambycidae above mentioned, for not one species is known to inhabit even two of the islands. The fact is the more remarkable as these beetles possess strong organs of flight and in fact fly strongly with the wind. Moreover they could also be carried in the larval and pupal state from one island to another in floating trees or their limbs. The Carabidae and

Proterhinidae, the former usually and the latter always flightless, are also mostly of different species on the different islands, but the species of *Cis* on the other hand are generally widely distributed throughout the group.

Many of the species of Cerambycidae, Curculionidae, Carabidae, Cioidae, and Anobiidae exhibit much variability in structure in individuals. Owing to their generally distinctive appearance this leads to no particular difficulty in the separation of the species of Cerambycidae, but in nearly all the other families many of the larger genera are extremely difficult to deal with. Probably no more difficult study in systematic entomology could be found than the working out of the Hawaiian Nitidulidae, Anobiidae, and some other groups.

The following 80 genera are, so far as is known, endemic: *Plagithmysus*, *Callithmysus* and *Clytarlus* (Cerambycidae); *Chaenosternum* (?), *Orothreptes* (?), *Deinocossonus*, *Nesotocus*, *Dysomma*, *Heteramphus*, *Oodemas*, *Anotheorus* (Curculionidae); *Labetis* (Cistelidae); *Apterocis* (Cioidae); *Holcobius*, *Xyletobius* (Anobiidae); *Eopenthes*, *Itodacnus*, *Dacnitus*, *Ceratotaxia* (Elateridae); *Apterocyclus* (Lucanidae); *Labrocerus*, *Argocerus*, *Eocerus* (Dermestidae); *Brontolaemus* (Cucujidae); *Antilissus* (Colydiidae); *Goniothorax*, *Gonioryctus*, *Nesapterus*, *Eunitidula*, *Orthostolus*, *Cyrtostolus*, *Apetasimus*, *Apetinus*, *Eupetinus*, *Nesopeplus*, *Nesopetinus*, *Notopeplus*, *Cillaeopeplus* (Nitidulidae); *Lispinodes*, *Nesomedon*, *Leurocorynus*, *Xanthocorynus*, *Holocorynus*, *Liophaena*, *Eudiestota*, *Eusipalia* (Staphylinidae); *Blackburnia*, *Deropristus*, *Atrachycnemis*, *Anchotefflus*, *Pseudobroscus*, *Derobroscus*, *Brosconymus*, *Anchonymus*, *Mauna*, *Disenochus*, *Chalcomenus*, *Barypristus*, *Baryneus*, *Colpodiscus*, *Prodisenochus*, *Apteromesus*, *Mysticomenus*, *Colpocaccus*, *Atelothrus*, *Mesothriscus*, *Mecostomus*, *Mecomenus*, *Metromenus*, *Mecyclothorax*, *Thriscothorax*, *Atelothorax*, *Metrothorax*, *Gnatholymnaeum*, *Nesolymnaeum*, *Nesocidium*, *Atelidium*, *Metrocidium*, *Nesomicrops*, *Macranillus* (Carabidae).

Proterhinus, representing the fam. Proterhinidae with its very numerous species, is only known at present by a single Samoan species other than the Hawaiian series.

One or two genera, though described from the islands and not at present known elsewhere, are, doubtless, introduced. These are not included in the above list. It may be noted that the greater number of new genera are found in the Carabidae, Nitidulidae, Staphylinidae, Elateridae and Dermestidae, groups classified by Dr D. Sharp. It is therefore quite possible that had the abundant species of the families Curculionidae, Cioidae, Proterhinidae, and Anobiidae, groups worked out by myself, been described and arranged by him, his profound and special knowledge of the Coleoptera would have led to the formation of many genera in these families likewise.

Chrysomelidae.—This family is represented by the introduced pest of the tobacco and various Solenaceous plants, *Epitrix parvula*. Probably it has not existed in the islands for more than 30 years, since it was not collected by Mr Blackburn. It is very abundant in some localities on the 'Poha' or 'Cape gooseberry,' *Physalis peruviana*, riddling the leaves, as it does those of the tobacco. One or two other Chrysomelidae have lately been introduced, but are not included in this work.

BRUCHIDAE.—*Bruchus prosopis* is now an excessively common beetle, and very injurious to the seeds of that most important tree the 'algaroba' (*Prosopis*). Four or five other species of *Bruchus* are likewise more or less common, the *B. chinensis* being frequently seen in vast numbers in stores, being more domestic than the others. The larger *Caryoborus gonagra* is also highly injurious to the seeds of various Leguminous trees.

CERAMBYCIDAE.—The single species of each of the genera *Parandra* and *Aegosoma* are apparently endemic. The former often breeds in great numbers in large, standing, but dead or partly dead, Koa trees, though by no means confined to these trees. Very minute examples, not one quarter the bulk of ordinary individuals, were found in small decaying logs of *Myrsine* and *Straussia* on Molokai, and very large ones in very wet logs of entirely decayed wood on Kauai. When mature the beetles may be sometimes found beneath close-fitting bark, their flattened form allowing of this mode of concealment. When disturbed, they will feign death. Sometimes they are attracted to lights at night. The larvae vary greatly in size according to the condition and nature of their food. They have small but quite well-developed thoracic legs. The ovipositor of the female is a very strong and hard organ, so that on casual inspection it might be mistaken for an aedeagus, and this sex wrongly supposed to be the male. The *Aegosoma* has much the habits of the *Parandra*, and is often found in company with it. Larvae are frequently found in the wettest and most rotten logs or even in the soil beneath these. They also attack healthy living trees of *Myoporum*, and in fact are polyphagous, though usually confined to dead wood. In tracts cleared of forest and planted with sugar-cane or coffee, they have been known to attack these beneath the soil. *Aegosoma* is very readily attracted to light.

Xystrocera globosa has been introduced within the past 20 years and is now very common in Honolulu. It breeds especially in the wood of some of the foreign Leguminous trees, that are such an ornament in the city. The beetle may often be seen resting on the trunks of affected trees in the daytime, or flying round electric lights at night.

Astrimus hirtus is a common species in and around Honolulu, but has not been noticed elsewhere. It particularly affects the old 'Hau' trees on the coast and may be found resting in the crevices of the bark by day, or seen running rapidly and in numbers over the surface after dark. It follows the Hau trees to an elevation of some 1200 feet up the mountain slopes, but is much less common there than near the beach. Widely distributed outside the islands to the west, it was probably an early introduction from Fiji or Tahiti.

Ceresium simplex is much more abundant and widely distributed than the preceding. Though most common amongst the algaroba trees of the lowlands, it has been occasionally bred from native forest trees at an elevation of 1500 ft. It sometimes swarms around the electric light at night. *Curtomerus pilicornis* is an introduction from the New World, now very common round Honolulu and occasionally found as high as 1500 ft. in the mountains. The larva is found in dead stems of various trees. We have observed it very commonly in the planted forest of Eucalyptus, immediately behind the city. It is also found in dried stems of some low-growing plants. The larva is parasitized by *Ischiogonus palliatus* and *I. pallidiceps*. *Clytus crinicornis* is excessively common throughout the islands on felled trees of *Prosopis*, and some of the larger Leguminous species, and does damage to the wood, if it is left lying exposed to its attack. It is not known to be attacked by parasites, and is confined to the lowlands and lower mountain slopes. The beetle is also frequently seen on various flowers.

There are 14 species of the endemic genus *Clytarlus*, which is closely related to the larger-sized *Plagithmysus*. Excepting *C. abnormis*, which perhaps is not a true member of the genus, all the species are attached either to *Sophora chrysophylla* or *Acacia koa*. No species are known from Molokai or Lanai, the almost total destruction of the native acacias on these islands being no doubt responsible for their absence. Most of the species are attached to the twigs and small branches of the trees, whereas the larger *Plagithmysi* feed usually beneath the bark of the trunks and larger limbs. The larvae of *Clytarlus* are now much destroyed in some localities by the comparatively recent introduction of the Braconid, *Ischiogonus pallidiceps*, and *I. palliatus* also attacks them. In one case we noticed about 90 per cent. of the larvae of *C. fragilis* to be destroyed by these parasites. On Maui, the remarkable bird, *Pseudonestor*, is continually hunting for the larvae and those of *Plagithmysus*, and its stomach is often entirely filled with this food.

Plagithmysus is a genus of larger and more conspicuous beetles than *Clytarlus*. There are 33 described species, and one or two still undescribed are known to me, as well as the larvae of several others distinct from these. They are of very remarkable appearance and often mistaken by non-entomologists for crickets or grasshoppers. Their wings are partly exposed, continuing the outline of the elytra, their folding being abnormal. The hind-body is extremely small, either in both sexes or at least in the males. Many of the species are able to produce a sound by the rubbing of the basal part of the hind legs, which are tuberculous, along the sculptured margin of the elytra; and some have stridulating organs on the middle and hind coxae, the middle ones operating on the adjoining edge of the thorax, the hind ones on a ridge on the basal segment of the abdomen. All have the usual stridulating apparatus on the scutellum. The more slender-legged species run with extraordinary rapidity on the trunks and branches of the forest trees, and they often perform curious evolutions, running in short curves or zigzags, and at times almost leaping. Sometimes the hind femora are notably spread outwards and kept well away from the elytra, as if to avoid their rubbing together. Individuals of many of the species exhibit great variability. Variation in size is very striking in many species, and there is very noticeable variation in structure of some, apart from size, e.g. in the form and development of the pronotal crest. The most conspicuous variability occurs in the colour of the legs of some of the species, which in this respect are dimorphic or trimorphic. (Plate XV, figs. 5—11.)

Thus in *P. aequalis* the hind femora are either red or black, and of 181 examined 70 had red legs.

In *P. blackburni* of 68, five only had red legs.

In *P. lamarckianus* black and red-legged forms are both common, the red femora of the latter usually being black or dark apically.

Of 98 *P. varians* 41 had black legs, 53 had black or dark legs with the apical part conspicuously red, while four were of a nearly uniform reddish colour.

P. varians, *P. lamarckianus*, *P. blackburni* and *P. darwinianus* are excessively closely allied species, and but for the fact that they have been carefully studied in the field, many might doubt their claim to be distinct. *P. darwinianus* is very constant in its uniformly red femora, which are merely of a darker shade in some than in others.

It is interesting to note the very different nature of the variation in these species. Thus *darwinianus* is constantly red-legged, *blackburni* is black-legged, rarely with red legs; *lamarckianus* has commonly either red or black femora, *varians* has a very common form quite unlike any of the others, a very scarce red-legged form like *darwinianus* or some *lamarckianus*, and a common black-legged form like *blackburni* and some *lamarckianus*. Other species, like *P. giffardi* and *P. bishopi*, with red femora black or dark apically are extremely constant and no noticeable variety has been found.

As with *Clytarlus*, the two native acacias, *Acacia koa* and *Sophora chrysophylla*, are favourite foods of *Plagithmysus*, for six species are found on the former and three on the latter tree.

The remaining 25 species are attached to a very varied list of food-plants (with the rarest exception each being confined to one). Thus Urticaceae, Myrtaceae, Myrsinaceae, Rubiaceae, Rosaceae, Rutaceae, etc., are attacked. In this connection it is interesting to refer to the closely allied species of the *P. darwinianus* group above mentioned. All these are common species and have been much observed in the field, and in some spots *P. darwinianus*, *lamarckianus* and *varians* have been found in numbers within a few yards of one another. Yet in spite of this and the fact that the females of *Plagithmysus* readily attract the males, not one example of either of these has ever been found to attack the tree affected by the others, *varians* being restricted to *Acacia koa*, *lamarckianus* to *Pipturus*, and *darwinianus* to *Sophora chrysophylla*. It is pretty certain that, however slight be the characters that separate these species, no interbreeding takes place between them, each remaining constant to its own food-plant. In fact, almost all the known species of the genus remain equally attached to their special food-plant, and as it might be supposed that change from one food to another may have in some of these cases led to the formation of species, we must refer to the case of *P. vitticollis* and its var. *longulus*.

The var. *longulus* is one of the most constant in a general way of the species of the genus and its larva lives beneath the bark of *Bobea*, a Rubiaceous forest tree. *P. vitticollis* (typical) affects a native species of *Rubus* (Rosaceae). Some of the examples (perhaps most) exhibit pallid colouring on the elytra, which is never the case with the var. *longulus*. Where the latter form occurs we have not found individuals attacking *Rubus*, though it grows there. The true *vitticollis*, found on *Rubus*, were a few miles from the locality, where the var. *longulus* occurred, and perhaps no *Bobea* grew there.

The case of *P. bishopi* is also remarkable. This is attached to *Pelea*, a Rutaceous tree. On one occasion near by some *Pelea* trees, affected by *bishopi*, I found a different tree, *Zanthoxylon sp.*, on which were specimens of this *Plagithmysus*. This particular tree had been known to me for years, when it was in sound condition, but had now been injured and attracted the beetles. There were many larvae feeding in the bark and the larger ones were taken and subsequently bred, yielding perfectly typical examples of *P. bishopi*. It may be noted that a curious variety (var. *gracilis*) of *P. bishopi* was previously found in the same locality on an unidentified tree other than *Pelea*, and I have some suspicion that this tree may have been of the same species as the one above mentioned. Although the individuals that were bred proved to exhibit no variation, yet it would have been very interesting to have continued this breeding, as in course of time it is by no means unlikely that variation would have shown itself. It remains to notice the case of *P. sulphurescens* and *giffardi*. The first specimens of *sulphurescens* were taken on the Urticaceous tree, *Urera sandwichensis*, and are described as having the base of the elytra fulvous. Some, captured on the wing I believe, had this part black. *P. giffardi* shows no variation and has the elytra black at the base. It is attached to *Myrsine* (Myrsinaceae), and this may have been the case with examples, taken flying, in my early collections. It is therefore uncertain whether the two are really distinct.

Whereas most of the species of *Plagithmysus* attack only unhealthy trees or such parts as are in unsound condition, some affect those that are apparently quite healthy. Thus *P. perkinsi*, as evidenced by the exit holes of the beetles, sometimes breeds numerously in trees of *Myoporum*, without noticeably injuring the tree, and the larvae of *P. speculifer* live in the stems of *Urera*, which appear quite sound. Many of the species can be obtained in any number by felling the kinds of trees that they affect, in many cases the beetles appearing in numbers two or three days after a tree is cut down and continuing to be found for weeks. *P. perkinsi, speculifer, vitticollis* and others, when in the larval condition, often feed in the actual wood or in the pith of the trees, but most of the species feed in or just beneath the bark, leaving long flat grooves, where they have fed. Before pupation, however, these usually enter the wood for that purpose. A few of the species are much more sluggish than the very active majority, though even these (e.g. *P. pulverulentus* and *perkinsi*) can run with speed on occasion. In dull weather the beetles are found with difficulty, in fact at such times and at night they appear generally to leave the trees they affect. In the very early morning we have several times seen individuals rise out of the underbrush and fly to the tree trunks, as the sunshine became warmer, they having evidently rested during the night amongst the lower-growing plants.

Like the common introduced *Clytus crinicornis*, the males are very active in pursuit of the females, and both sexes copulate with different individuals. Where there is conspicuous di- or trimorphism the females will pair successively with males of each form. The male often accompanies the female as she oviposits, holding on with the front and walking with the hind legs, and every now and then copulating afresh.

Plagithmysus is attacked by the two Braconid parasites of the genus *Ischiogonus*, one of which first appeared about 15 years ago, while the other (which also inhabits Fiji) is a more ancient introduction. Several parasites may be bred from a single partly grown larva. On one occasion, of over 80 larvae of *P. solitarius* taken on the mountains just behind Honolulu only two small individuals had escaped these parasites.

The species of *Callithmysus* resemble those of *Plagithmysus* in habits, and the two genera are intimately connected. The three species inhabit only Oahu, and one of them, *C. cristatus*, was formerly considered to be a *Plagithmysus*. This species seems closely connected with *P. robustus* (*pulverulentus*), and the Maui species *P. funebris* is also somewhat similar to these. It would appear that all or most of the known Oahuan *Plagithmysus* have a tendency towards the *Callithmysus* form, the thickness of the hind legs being very noticeable as compared with those of allied species from the other islands. *C. cristatus* is attached to *Acacia koa* and is often found in company with *P. pulverulentus*, but *C. koebelei* is found on *Pipturus* and *C. microgaster* on *Bobea*, all of which trees are favourites of *Plagithmysus*.

Curculionidae.—The 24 described species of *Rhyncogonus* are endemic with the possible exception of one or two, which may be natural immigrants. These *R. vestitus* and *R. extraneus* live outside the forest region and are attached to apodemic plants.

The former has been observed in enormous numbers, frequenting *Vitex trifolia* on the sandy isthmus on Maui, the latter affects verbenaceous weeds on Oahu. The forest-frequenting species are rather diverse in habits, some moving around freely in the daytime, others resting at that time beneath bark, in moss, or amongst the foliage. Many are gregarious or sub-gregarious, so that occasionally a number of examples may be found resting side by side. Although many are more or less rare insects, there is evidence that some of these occur in great numbers at times, or at least have been very numerous, since in some localities we have found the soil full of the detached elytra, when living examples were not to be found. Many of the species are very imperfectly known, and in spite of their considerable size are not easily distinguished, being notably variable both in superficial appearance, and in points of structure. Their headquarters are apparently on Kauai and Oahu at the one extremity of the group; none are known from Hawaii at the other end and but few at present from Maui. There is no doubt that many of the species are very local or restricted in range on the island that they inhabit, so that many more species, or at least varieties of known forms, should be discovered in the future. While some like the dense and wet forests, others inhabit very dry localities, with scattered brush or small trees. Some of the species, such as the well-known *R. blackburni* and *koebelei*, are known to be polyphagous, frequenting various forest trees and even some species of ferns. The life-history of the former is to some extent known and no doubt others will be found to resemble this in a general way. The eggs are laid in numbers between two leaves of *Acacia koa* (and no doubt of *Straussia*, *Bobea*, etc.) which are glued together. The young larvae on emergence drop to the ground and no doubt feed on the decaying vegetable matter contained in the soil. The eggs of *R. blackburni* are parasitized by the Chalcid, *Eupelmus rhyncogoni*, one parasite emerging from each egg. No doubt other and rarer species will be found to have similar parasites, the number of eggs laid being out of all proportion to the number of adult beetles that are found. On Kauai the scarce little thrush, *Phaeornis palmeri*, is a most successful hunter of *Rhyncogonus*, for in all cases these beetles were found in the bird's stomach, even to the exclusion of all other food, while they have been found in no other bird.

Pantomorus fulleri is an injurious beetle, imported, doubtless, with hot-house plants from California. It was not known in Mr Blackburn's time. It first became conspicuous on Maui, but it is now injurious on Hawaii, Oahu and Molokai. Of the forest trees it is very partial to *Acacia koa*, the eggs being laid in masses in cracks of the bark or in swellings caused by a Tortricid caterpillar. The young larvae fall to the ground and feed in the soil, the habits being much like those of *Rhyncogonus*. The beetle itself defoliates the rose, fruit-trees, and other plants, and in default of other food it will attack young sugar cane. Being apterous, it could probably have been easily controlled, if not exterminated, in the first period after its introduction.

Cylas formicarius is another introduction, which still occasionally reaches the islands in consignments of sweet potatoes. The larvae is common not only in these, but also in some of the wild Ipomoeas, especially *I. pes-caprae*.

The 21 species of *Acalles* are all endemic. They are difficult to collect and very imperfectly known at present, and being often variable, with great sexual differences, are still more difficult to separate specifically. Moreover examples in different condition as to freshness have a very different appearance. Some of the species can, however, be easily bred from dead wood, and until long series of many species are obtained in this way their number will remain quite uncertain. With the exception of *A. tuberculatus* found beneath small logs lying on the ground, all the species frequent standing trees. They breed in dry dead branches, and are apparently absent from the wettest forests. No parasites are at present known to attack this genus. The unique type of *Chaenosternum* has much the appearance of an abraded *Acalles*. *Hyperomorpha squamosa* described (from a single specimen found near Honolulu) by Mr Blackburn, is probably an introduction. I have felt some doubt whether this may not be *Cryptorhynchus batatas*, an insect now common and attacking the sweet potato and other Ipomoeas, and itself not a true *Cryptorhynchus*. Another recent introduction is the mango weevil *C. mangiferae*, already after a few years' occupation, only too abundant on Oahu.

Sphenophorus obscurus is the well-known 'cane-borer' of the Hawaiian islands, a most injurious species to sugar cane, but breeding also occasionally in bananas and various palm trees. The Hawaiian and Tahitian form, introduced originally into Maui from Tahiti, and later still reaching Fiji, is a different race from that found in New Guinea and the Moluccas, the New Guinea form having also been imported into Australia. The three species of *Calandra* are introduced, and include the common rice-weevil, the tamarind weevil (*C. linearis* var. *striata*) and a more remarkable species, *C. remota*. This latter is usually found in banana stems but also sometimes occurs in those of coconut trees on the coast near Honolulu.

The Cossoninae contain the most important and numerous genera and species of Hawaiian weevils. The genera *Deinocossonus*, *Nesotocus*, *Dysomma*, *Heteramphus*, *Oodemas* and *Anotheorus* are endemic, while *Orothreptes* though not at present known from elsewhere, will probably prove apodemic. There are 17 species of *Dropththorus*, one of these *D. distinguendus* being probably apodemic. The rest are true natives. *D. distinguendus* is common in the town of Honolulu, often riddling boards, or wood that is laid upon the ground in gardens. It is also very widely distributed throughout the forests. Most of the species are polyphagous, their larvae attacking many kinds of dead wood, either that of still standing trees, or of rotten logs lying upon the ground. Some species, however, are more particular. *D. oahuensis* is usually found in the dead wood of standing trees of *Pipturus*, and *D. pusillus* inhabits decaying tree-ferns. *D. modestus* is also rarely found in the latter, as well as in many kinds of dead wood, hard or decayed. The species are difficult to separate, and frequently colonies of several species are found mixed. The remarkable little insect, for which I made the genus *Thalattodora*, supposing it to be a natural immigrant, proves to be such, and is elsewhere known from Florida and Australia. It is *Dryotribus mimeticus* of Leconte and Horn. It is interesting to find that this beetle has presumably at some distant time reached the small and remote lying island of Midway, and there has given rise to an allied species. It is not known whether typical *D. mimeticus* occurs there also. Examples from the main islands of the Hawaiian group are in no way distinguishable from American specimens.

Of the three described species of *Pentarthrum*, *P. obscurum* and *blackburni* are certainly introduced, the latter attacking boxes of foreign wood in Honolulu, and the former is, I believe, also known from Fiji. It attacks trees of foreign origin. Another species of *Pentarthrum* has recently been imported and lives in the stem of sugar cane. *P. prolixum* on the other hand is truly endemic, found only in the mountain forests, and confined to the native tree-ferns. It exhibits considerable variability. *Orothreptes callithrix* is widely distributed in the islands, and the genus, if not the species, will no doubt be found elsewhere. It is attached to the naturally present, but not endemic tree, *Pisonia umbellifera*. The minute weevil, *Deinocossonus nesiotes*, is found on various kinds of dead wood, *Metrosiderus*, *Alyxia* etc. It is confined to the native forests, from 1500 ft. to 4000 ft., and shows considerable variability. The natural immigrant in drift wood, described by me under the name of *Haloxenus immigrans* (Vol. II, p. 148), belongs to the genus *Macrancylus*, originally described from Florida. *Pseudolus longulus*, which we have found in consignments of plants from Fiji, is no doubt an imported species. *P. hospes*, of later introduction, and first found in the boards of the floor of a room in Honolulu, is now far commoner in the mountains round the city than *P. longulus*. Where the latter was once common one now finds only *P. hospes*, as if the latter had in some way dispossessed the other. *Phlaeophagosoma tenuis* is also an importation, which in recent years we have found amongst Fijian plants, when inspecting these on their arrival at the wharf. The genus *Nesotocus*, with four species, is a very remarkable endemic form, included by Champion in a small group of Central American genera, distinct from, but allied to the Cossonini. Sometimes these insects are not rare beneath bark or in crevices of the limbs or trunk of *Cheirodendron*. Whereas in drier districts, e.g. at Kilauea, Hawaii, the beetles remain concealed and at rest during the day, in very wet and dense forests, like those of some parts of Puna and the Kohala mountains, they are active by day, running rapidly over the tree trunks like many Longicorns. Dead branches of *Cheirodendron* are often riddled by the borings of these species. Individuals vary greatly in size, and, in accordance with this, the structure is much modified in the small examples, the form of the rostrum, antennal joints etc. becoming affected. *N. kauaiensis* is remarkable in having the antennae of the ♂ inserted in a different position on the rostrum from that of the others, though otherwise excessively closely allied. *Dysomma sylvicola*, only once found amongst dead leaves, is of uncertain affinity.

The 10 species of the genus *Heteramphus* are of great interest. They seem to be best represented on Oahu, which yields five of the known forms. *H. filicum* is common in decayed parts of the stems of tree-ferns in the mountains near Honolulu. It exhibits a good deal of variation, and different colonies apparently sometimes differ considerably in appearance. *H. wollastoni, foveatus* and *cylindricus* are all common on the liliaceous plant, *Astelia*; sometimes all are found in company on a single plant, sometimes two of the species are mixed, sometimes only one occurs. On one occasion a single plant yielded not only these, but *H. hirtellus* as well! It is very remarkable to find all these species living absolutely together, and with perfectly distinct specific characters, when we must suppose, that all originally were the product of a single form. In spite of apparently an identical mode of life, species formation of the most distinct kind has taken place. Of the four species, *H. cylindricus* exhibits much variation, the others are much more constant. *H. haleakalae* and *H. frater* are found beneath rotting logs in the same locality and may not be distinct species; *kauaiensis* has the same habit, and *molokaiensis* was found in wet moss on tree-trunks.

Oodemas is a remarkable endemic genus with 48 described species, with others known, but undescribed. The species are extremely difficult, many of them being variable, while some exhibit marked sexual differences and others little or none. The larvae of all feed on dead wood or ferns, excepting *borrei*, which is common beneath stones, where only a scanty vegetation of grass-tufts and a few low plants exist. *O. brunneum* is found in dry frond-stalks of *Pteris*. Many of the species, like *O. aenescens*, are polyphagous, attacking the dead wood of many kinds of trees. In fact this species and some others are even found in stems of low plants. Others, however, are either solely attached to one sort of tree, or, at least, are rarely found on more than one. Some of the species, e.g. *O. corticis*, *O. nivicola* and *O. multiforme*, are very numerous in individuals and many of the species are gregarious, so that a number of examples may be found in proximity. Many, however, are difficult to collect and are still very imperfectly known. No parasites of these beetles are at present known, but they are a favourite—perhaps the favourite—food of several species of the remarkable birds of the genus *Heterorhynchus*, and the allied *Hemignathus* also devours large numbers of them.

Anotheorus with three species is allied to the preceding. *A. montanus* breeds in the dead wood of *Aleurites, Acacia koa, Pisonia* etc. in the mountains just behind Honolulu and elsewhere on Oahu. It appears to have become very much more abundant of late years than was formerly the case. Once difficult to obtain, it is now a common beetle, and is sometimes found in company with the introduced *Pseudolus hospes* and *Dryophthorus distinguendus*.

Scolytidae.—Three genera with 24 species are considered in this work, but one or two other genera are now represented by recently imported species. Of the 19 species of *Xyleborus* two of the most abundant, *X. confusus* and *X. pubescens*, are introductions by man, and one or two of the other species are very likely to prove to be foreign. *X. pubescens* (*immaturus* Bl.) is an injurious species, attacking trees that are temporarily unhealthy, and in that case sometimes causing their death, when otherwise they would no doubt recover. It may be seen in vast numbers breeding in trees that are scorched by forest fires, and is sometimes common in the city of Honolulu. It has also been introduced into Queensland, where it was observed in myriads in felled timber in one locality, and no doubt it will become ubiquitous throughout warm countries, wherever the climate is suitable. The native species are very difficult to distinguish from one another, and there is great sexual dimorphism, so that it is not possible to associate the sexes in the present state of our knowledge. The males are usually much rarer than the females, and large colonies of the latter may be found without a single example of the former sex. One group of large-sized species is attached to the tree *Cheirodendron*. Others attack *Acacia koa*, *Pipturus* and other trees, while the introduced species are partial to *Aleurites triloba*, the apodemic 'Kukui' tree. For most of the endemic species a tree has to be in a particular condition of decay or disease in order to be attacked. The species of *Hypothenemus* are, doubtless, all introduced. *H. eruditus* is sometimes found in the covers of books, as in other countries, but it also breeds very freely in the open, in dry stems of many plants, and in the twigs of many bushes and trees. It is parasitized by a minute Bethylid, probably a *Cephalonomia*. *H. insularis* and *H. ruficeps*, described by me, are varieties, I believe, of this variable species. *H. maculicollis* is often found with *H. eruditus* and is very common in twigs of tamarind, Hibiscus, and many other trees and plants. It is also fond of boring in the trunks of large avocado pears (*Persea*) when these are not quite healthy, and aggravates their condition. *Crossotarsus externedentatus* sometimes joins in the attack on this tree and becomes very numerous. The species of *Hypothenemus* are mostly confined to the lowlands or lower elevations rarely attaining an elevation of 2000 ft. in the mountains.

ANTHRIBIDAE.—Represented by only foreign forms, unless, as is improbable, *Araecerus constans*, which is very closely allied to the introduced *A. fasciculatus*, should prove to be endemic. It is very common in the Kona district of Hawaii, frequenting the flowers of *Argemone mexicana*. *A. fasciculatus* is one of the commonest of beetles, breeding in immense quantities in the fruits or seeds of many native and foreign trees, and also in dead wood, dry stems of sugar cane etc. It is occasionally parasitized by an *Eupelmus*. It ranges from the coast, throughout the mountain forests of all the islands. Of recent years two or three exotic Anthribids have become imported and established. These belong to the common tropical genera that have the antennae greatly elongated. One of them we have found swarming in consignments of coconut drupes imported for seed.

Proterhinidae.—This family, excepting for a single species, which inhabits Samoa, is at present only known from the Hawaiian group. Here about 130 species have been recognized, and these form an assemblage exhibiting great variety of structure. The discrimination of the species is a matter of very great difficulty owing to the variability of many of them, and which are true species and which mere local forms or varieties is very incompletely understood. It is quite certain that many of the species apart from great variability in examples taken in the same locality, also exhibit local variation, and further some are known to vary according to the nature of the food-plant. There is often great variability in the size of the individuals of a species, and concomitantly with this, the structural characters become modified. Some of the species are polyphagous, feeding in the dead bark of widely different trees. Thus *P. vestitus*, which may be considered the type of the genus, is found on the Kukui, *Aleurites* (Euphorbiaceae), on *Pipturus* (Urticaceae), on *Charpentiera* (Amarantaceae), etc. This species does not show any particular variation in accordance with the food-plant. Other species, on the contrary, such as *P. oscillans* and *P. laticollis*, are attached only to one species of tree, those just mentioned breeding only on *Acacia koa*. Stragglers may be found accidentally on other plants, having become dislodged from their proper habitat; and even at some distance, when, after high winds, by which branches or twigs are detached and carried to a distance, the beetles leave these in search of a proper breeding place. Several species, e.g. *P. longulus*, are found only on tree-ferns, while *P. pteridis* is attached to *Pteris* and *P. sharpi* to an undetermined, but not arboreal, fern. A few species leave the stems to feed on growing leaves of the trees they affect, and some form burrows in the leaf stalks. Many of the species are gregarious and it is a common occurrence to find a dozen or even many more individuals resting side by side beneath dead bark. Sometimes quite different species are associated together in these flocks. The apodous larvae are often found feeding in the bark, beneath which the adults congregate, but some enter the solid wood of hard trees, while some breed in the leaf-stems of ferns. *Proterhinus* is ubiquitous throughout Hawaiian forests, where any native Coleopterous fauna remains, and ranges above these to a height of 9000 ft. or more on the higher mountains, affecting the shrubs that grow at high elevations. They entirely cease to exist in the lower forests, where these are well occupied by the ant *Pheidole megacephala*, which rapidly exterminates them. Doubtless, there has once been a considerable number of species, inhabiting areas at lower elevations, which are now extinct. Not a single species is now known from the coastal region of the islands, though the Samoan species was found in coconuts, that had been grown on the coast, in that group. It is probable that numerous species remain to be discovered outside the Hawaiian islands, and possibly some forms will be found connecting *Proterhinus* more closely with the New Zealand *Aglycyderes*.

Apart from size, colour and clothing, the variation that has been noticed to exist in individuals of colonies of *Proterhinus* affects the size of the eyes, length of antennal joints, the shape of the pronotum and the development of the humeral angles of the elytra. As all these characters have to be used for the differentiation of the species, it may readily be understood, that years of study may be necessary before a satisfactory elucidation is attained. With regard to the variation in the individuals of the colonies mentioned above, it is worthy of note that we have found in the case of some species that whereas the individuals of one colony exhibit no variation of note, in another colony may be found examples so variable that, had the extreme forms been found apart, one would have hesitated to consider them as belonging to a single species. Whether this is due to the mating of similar parents in the one case and of dissimilar ones in the other can only be settled by experimental breeding in the homes of the insects. They do not thrive if removed from the forests, and may even be affected in superficial characters, when bred on the lowlands. Thus a series of *P. vestitus* reared in Honolulu could not be matched in colour by any of many specimens gathered from the very same trees at an elevation of about 2000 ft. in the mountains.

OEDEMERIDAE.—*Oxacis collaris* described from the islands, is certainly an importation and has often been seen in great numbers on foreign trees and shrubs about the town of Honolulu, and of recent years has spread throughout the island of Oahu. Doubtless, it will reach the other islands, if it has not already done so; sometimes it is extremely abundant at light. It sometimes visits certain flowers in the daytime, and at a time when many of the shrubs in Honolulu were covered with the Coccid, *Ceroplastes rubens*, it literally swarmed over the foliage, probably attracted by the excreted honey-dew. Quite recently one, if not two other Oedemerids have been imported into the islands, but have not yet become generally abundant.

ANTHICIDAE.—The two species of *Anthicus*, which frequent the neighbourhood of the coast may be natural immigrants, being widely distributed in the islands, and one of them, at least, is very abundant. *A. oceanicus* has been recorded from the Marquesas.

CISTELIDAE.—The genus *Cistela* contains seven described endemic species, and *Labetis* with five is supposed to be endemic. The species of *Cistela* are closely allied and difficult to determine and as a rule not numerous in individuals, so that they have been imperfectly studied. They appear to be diurnal as they are found on the foliage of trees and on ferns in the daytime and occasionally are seen on the wing, as is the case with the *Labetis* of Kauai. The species of the latter genus that occurs on Hawaii, however, is nearly always found resting beneath the bark of *Acacia koa* in the daytime, several examples being sometimes found in company and we do not remember seeing it active in sunshine like the others. The species are extremely closely allied and the larvae are not at present certainly known, but Tenebrionid-like larvae, superficially somewhat similar to those of some Eucnemidae and found with these are probably to be referred to the Cistelidae.

Tenebrionidae.—The seven genera recorded are of little interest, most of the species being certainly importations, but four *Epitragus diremptus, Platydema obscurum, Opatrum seriatum,* and *Sciophagus pandanicola* are possibly natural immigrants. The latter now seems to be rarely or never found. There are a few other Tenebrionids now present, of quite recent introduction. *Alphitobius lateralis* appeared on Oahu about 20 years ago, and has since spread and become one of the commonest of insects. The larva of *Opatrum* is not infrequently found in the soil beneath the droppings of cattle, and is probably predaceous on the Diptera so abundant in these.

Cioidae.—The 42 species representing this family have been placed in two genera, the apodemic genus *Cis* having 29, and the endemic *Apterocis* 13 species. They are a varied assemblage of forms, and will probably at some time be split into more numerous genera. *Cis pacificus* is a very commonplace species, as compared with its congeners, and resembles foreign forms. It is very common in foreign fungi growing on trees that are not endemic, and I suspect it will itself prove to be foreign or an importation. One or two other species are likewise doubtfully native. Very few of the Hawaiian *Cis* are found in the larger fungi that grow out from the trunks of trees, but *Cis roridus* and *bimaculatus* are found in these, though not confined to them. Most of the species live beneath bark of trees, feeding on the smaller or microscopic fungi that grow in this situation. *Cis lacticulus* we have found, both mature and larval, on dead fallen leaves of *Freycinetia*, the larvae no doubt feeding on the fungi growing on these. Many of the species are widely distributed throughout the islands and very numerous in individuals, and they also exhibit much variability. Some of the species of *Cis*, as also all of those belonging to *Apterocis*, are flightless. With regard to the former it is not certain whether some may not have fully-winged and flightless individuals as well. One or two of the species referred by me to *Apterocis*, I believe, from more recent examination, to be fully-winged and they should be transferred to *Cis*. The Hawaiian forms are a very interesting series and particularly require close observation in the field and need still more to be bred in captivity, in order that the limits of variation of the species may be correctly determined. Some of the wingless Bethylids (*Scleroderma*) are sometimes bred from wood containing these beetles, but it is not certain whether they are parasitic on them, or on other insects (especially caterpillars) found in the same wood. The minute Braconid, *Echphylopsis nigra*, is also obtained from wood in which these and other small endemic Coleoptera are breeding. The abundance of the beetles and the comparatively great rarity of these parasites show that, if parasitic on *Cis*, the latter are of little effect in reducing the numbers of the former.

Bostrichidae.—The six species, each belonging to a different genus, are all introductions by man. They are none of them forest insects. Some of the species are very injurious to felled timber, whether destined for fire-wood or for other purposes, reducing the wood in time to a powdery condition, by their numerous burrows. *Bostrichus migrator* Sh., a species we have found in Mexico, has proved destructive to wooden tanks and even to the wood of some houses. *Xylothrips religiosa* and, I believe, some of the other species are attacked by the introduced Braconid, described by me as *Hormius* (?) *peregrinus*, which apparently really belongs to the little known Helconine genus *Euscelinus* of Westwood.

LYCTIDAE.—Two imported species of *Lyctus*, one being the well-known European *L. brunneus*, are of no particular interest. We have seen *L. brunneus* in great numbers beneath the bark of large trees injured by fire.

ANOBIIDAE.—The imported insects of the genera *Catorama*, *Anobium* and *Lasioderma* are importations by man and of no special interest, except to the economic entomologist. *Holcobius* with 12 and *Xyletobius* with 52 species are endemic and allied to one another. The species of the former are nocturnal, those of the latter diurnal and sun-loving, and often seen in numbers basking on the leaves of forest trees. *Holcobius* may be found sitting near their burrows on the trunks of dead trees after dark. Some of the species of *Xyletobius* are very abundant and of wide distribution. They breed in dead wood as a rule, but some of the species have been taken ovipositing in sickly trees, which, however, were by no means dead. It appears that some and perhaps many of them are particular in their choice of food, feeding only on one species of tree. Some of the larger species are known to be parasitized in the larval condition by the Encyrtid genus *Eupelmus*, and they are occasionally found in the stomach of insectivorous birds. They do not thrive in the densest wet forests and sometimes are quite absent from these, but are most abundant in more open and drier woodlands. In their company one frequently finds the endemic Dermestidae which seem very regularly to be associated with them, and sometimes considerably resemble them in superficial appearance. The definite variations in the pattern of many *Xyletobius* is of an interesting nature[1]. Sometimes these distinct varieties of a species are all found in company, but sometimes they appear to be of local occurrence. The larger insects of the genus *Holcobius* are sometimes found on tree ferns, but it is not known whether they breed in these. Some species have been bred very freely from very dry dead wood, e.g. from posts used as supports of an outhouse. Occasionally examples are attracted to light at night.

The species of *Mirosternus* are very numerous, no less than 70 apparently distinct forms having been distinguished. The discrimination of the species is extremely difficult, since many are closely allied to one another, some are variable, and whereas some present extreme sexual differences, others hardly differ in external sexual characters. Consequently the number of species given is likely to need some modification. In their habits the *Mirosternus* resemble *Xyletobius*, being sun-loving insects, and very sparsely represented in the wettest or densest forests, but in more open woods some species are

[1] See Plate XVI, figs. 11—16, for varieties of *X. proteus*.

very numerously represented. Many of the individuals, that are dislodged by beating bushes, take wing and may sometimes be seen beating up against the wind to regain their position. They are often observed in numbers on the upper side of the leaves, remaining motionless, rarely active. Only a fraction of the number of known species, however, occurs in profusion, many being very scarce. They breed in dead wood, and when the bark is stripped from dead Koa trees, one sometimes finds the remains of thousands of examples beneath this. They chiefly affect the same trees as the species of *Xyletobius*, and in fact are generally taken in company with these. It is not definitely known whether they are attacked by parasitic Hymenoptera, but it is most probable that the small Chalcids of the family Miscogasteridae, which parasitize other small Coleoptera, affect them also. They are sometimes found in the stomach of native Drepanidid birds, but not as commonly as are the brassy weevils of the genus *Oodemas*. Species of endemic Dermestidae are very commonly found in company with *Mirosternus*, and some of them superficially resemble the latter in appearance. Although described first from the islands, *Mirosternus* is now known to inhabit tropical America, and the Hawaiian forms are probably derivatives from a very ancient introduction from that region.

CLERIDAE.—Represented only by three widely distributed species, introduced, no doubt, by man. The two species of *Necrobia* (*rufipes* and *ruficollis*) are often abundant in the remains of dead animals, but *Tarsostenus univittatus* does not seem to flourish in the islands. It is generally found on dead posts bored by various xylophagous beetles, and we have only seen it at large at night time.

MALACODERMIDAE.—*Helcogaster pectinatus* has been found only in and around houses in Honolulu, and we once observed a small swarm of males, entering a room through the meshes of the mosquito blinds covering the window. Probably they were attracted by a female somewhere within the room, but the latter was not observed.

Caccodes debilis is likewise a Honolulu insect, generally found in or close to houses, but once observed in a plantation of foreign trees a few miles from the town. Both these species, sole representatives of the Malacoderms, are, doubtless, importations, though not yet known elsewhere.

ELATERIDAE.—Five genera, each represented by a single species, are certainly importations. Of these *Melanoxanthus melanocephalus* is often seen in the windows of stores in the town of Honolulu, but is also found in the country. *Adelocera modesta* is common on Oahu, but during the period of my systematic collecting was not observed on the other islands, though it may now have reached some of these. *Simodactylus cinnamomeus* is generally distributed throughout the group, the beetles being often observed in numbers at the bases of leaves of liliaceous and other plants, and also on flowers, while the larvae are found in decayed wood, stems of sugar cane, &c., and are known to be at least partly carnivorous. The large *Chalcolepidius erythroloma* is sometimes numerous on Oahu, especially near Honolulu, but has not, so far as is known, yet reached the other islands. It is commonly seen at the sap oozing from fungus-attacked trees in the lower forest, especially on the Koa and Kukui, and the larvae occur in the dead wood of the latter. We have also found these in the wood of living orange trees, once in such numbers as to be apparently doing injury, but the trees were sickly.

Monocrepidius exsul is the latest importation in the Elateridae, it having been first noticed in 1900, and now is the most plentiful of this family on Oahu. It is attracted to light on dark nights in extraordinary numbers, especially in the vicinity of cane-fields, where it breeds in the trash.

Eopenthes is an endemic genus with 33 described species, many of which are rare and imperfectly known, the species being extremely hard to distinguish. Some have a constant colour pattern, while others are very variable. In the latter case individuals of one species may be of two or three quite distinct patterns of colour, these same colours being of specific value in other species and not varying. These beetles are remarkable amongst the Hawaiian Coleoptera for several reasons. They are almost entirely summer insects or at least do not occur between November and March. They are almost the only native beetles found visiting flowers for the sake of the nectar, being especially fond of the blossoms of *Metrosiderus*. They are also largely of diurnal habits. Unfortunately many of them appear to be rare or this may be partly due to their comparatively short season, on account of which the travelling collector does not happen to be in the right place at the right time.

Eopenthes konae, a very variable species, is very abundant and widely distributed on Hawaii and is found in all sorts of situations, even under stones. The larvae are common objects in the forests of all the islands, being found in rotten wood, and are often seen in numbers, when adults are rare, or not observed at all. No parasites were obtained from the few I was able to rear.

Itodacnus, another endemic genus with eight species, is nocturnal in its habits, or at least some of the species are so, and *I. gracilis* may be seen on the wing in numbers at dusk. In the daytime they hide beneath the bark of trees, sometimes a considerable number in company. The larvae also have been found beneath bark, and the adults are attracted by light. *Dacnitus*, with a single species, is probably a terrestrial species. It was only once found beneath a log on very wet mud, in a boggy forest. It is allied to *Itodacnus*.

The Eucneminae are represented by 33 endemic species of *Dromaeolus* and a single one of an endemic genus *Ceratotaxia*. They have been even more imperfectly collected than the true Elaters, and as in these, the larvae are more numerous than the adults. Unless found full grown, these larvae generally die if removed to the lowlands, and no beetles are raised. They are, however, easily reared in the forest region and until this has been extensively done, the species are likely to remain uncertain. The adults are usually found beneath the bark of trees, or, when just freshly emerged, in logs or the dead stems of growing trees, where the larvae have fed. Some like *D. perkinsi* can bore into the hardest wood, others like *D. obscurus* have been found in the wettest and softest of rotten logs. Some occur in the moss on tree trunks, and a few species are, but very rarely, taken on the wing in the sunshine. Some of the species are wingless. They are not partial to flowers, like *Eopenthes*. *Acacia koa* is a favourite tree with this genus, and a number of species are attached to it. On old koa trees great quantities of the remains of these beetles are often seen beneath the bark, probably in evidence of many generations having bred therein.

Buprestidae.—Unrepresented in the native fauna, but with three imported species established. Two of these are common North American species of *Buprestes* and appear not to thrive in the islands. Perhaps they are not really established, but are brought in from time to time with the heavy shipments of lumber. An obscure *Agrilus* attacking leguminous trees, probably more or less unhealthy, was so abundant in 1900, as to appear to be an injurious insect near Honolulu.

Scarabeidae.—*Trox scaber*, *Aphodius lividus*, three species of *Ataenius* and *Saprosites pygmaeus*, an undetermined *Psammobius* and *Adoretus tenuimaculatus*, all imported by man, alone represent this large family. The latter, introduced from Japan about 1896, is an injurious insect, and for a time defoliated many ornamental plants, and threatened to destroy some of the forest trees. Afterwards becoming attacked by a fungous disease, and this being artificially spread, it ceased to become so serious a pest, though always numerous. Subsequent to its introduction, we have found the larva abundantly in soil contained in boxes of plants brought from Japan, when inspecting introduced plants just landed from a steamer from Yokohama.

Lucanidae.—Represented only by the endemic genus *Apterocyclus*, found only on Kauai, where seven forms have been distinguished. All these forms were collected within an area of a few square miles and their specific distinction seems uncertain. The larva has been found in and beneath rotten wood, and a newly emerged beetle was once taken in a rounded cavity in the soil beneath cow-dung in an open place away from trees or fallen wood.

Dermestidae.—The allied genera *Labrocerus* with 18, *Argocerus* with two, and *Eocerus* with a single known species are all endemic and of considerable interest. Some of the species are quite common and we have always found them in places frequented by, and usually in company with, Anobiidae, and there is probably some real connection between the two, though their habits are not known. Like the Anobiidae they sometimes frequent the foliage of plants, and some of them have a striking superficial resemblance to certain species of the former. These superficially similar species in the two groups are sometimes actually found in company. On one occasion an Anobiid was found far below the usual range of these insects, near the coast, and even in this case a *Labrocerus* (*L. curticornis*) was found on the same tree. It seems possible that the larvae of these Dermestidae prey on the Anobiidae. Larvae of Dermestids beaten from dead branches of trees in the forests, no doubt belong to *Labrocerus*.

Attagenus plebeius is often found in houses, and is certainly introduced, as also are the two species of *Cryptorhopalum*, both of which are found in Honolulu and probably all over the islands, on the lowlands. The larva of one species is often noticed on the sheath of dead palm leaves, when these fall from the trees. The two species of *Dermestes*, common introduced species, are abundant in carcases of dead animals, and range to high elevations in the mountains.

Coccinellidae.—Only four species of this family occurred in the islands twenty years ago, but since that time numerous genera and species have been imported for economic reasons. These have now, many of them at least, become the commonest and most ubiquitous of insects. The four species found by Mr Blackburn, all still occurring, are, doubtless, importations by accident, excepting perhaps *Scymnus ocellatus*, which might be an immigrant. I have been told that this species is identical with a species in the Galapagos Islands. *S. discedens* Sh. appears to be the *S. debilis* of Leconte and *S. vividus* Sh. is said to be *S. loewii* of Mulsant. *Cycloneda abdominalis* is certainly much less numerous than was the case twenty years ago, but now it has to compete with a number of other introduced species, which have the same food and are far more successful.

Erotylidae.—Represented only by *Euxestus minor* not known from elsewhere, but probably an importation, as it has only been found on Oahu, and by *Eidoreus minutus*, which has been found actually in Honolulu, and is very unlikely to be endemic.

Corylophidae.—The five genera of this family contain, so far, only six species, which are all known only from the islands at present, and four of these have only been found on Oahu, mostly near Honolulu. *Sericoderus pubipennis* and *Orthoperus aequalis* are of wide distribution throughout the group, in the mountains, and are found in fungi on Koa and Kukui trees, but it is probable that these, as well as all the others, will be found elsewhere. These others belong to the genera *Sacium*, *Anisomeristes* and *Corylophodes*, the latter with two species.

Mycetophagidae.—Of the two species of *Litargus*, *L. balteatus* is American, and *L. vestitus*, though described from the islands, will doubtless prove to be foreign, as it has been found out of the range of endemic beetles on foreign trees. I think that both species occur in the town of Honolulu at times, and one or other species of the genus sometimes abounds in decayed stems of sugar-cane. *Propalticus oculatus* is also certain to prove an introduction, for though it occurs in the forests, we find it in the town of Honolulu, sometimes in dead stems of introduced *Hibiscus*. *Typhaea fumata* is of course an importation.

Mycetaeidae.—Represented only by the introduced *Mycetaea hirta*, and it is uncertain whether this has become established.

Lathridiidae.—Only represented by the foreign *Lathridius nodifer* and *Colovocera maderae*, the latter first observed in 1900 in foreign ants' nests, in and close to Honolulu. *L. nodifer*, though widely distributed, only occurs in very small numbers, usually amongst fallen leaves in the forest.

Cryptophagidae.—*Cryptophilus integer* an introduced species, found in Honolulu, and the European *Henoticus serratus*, also, no doubt, imported, are the only representatives of this family.

Cucujidae.—This family is of more importance than the several preceding, though six of the eight genera represented are represented probably by only foreign species, importations by man. *Brontolaemus* is an endemic genus with four closely allied species, showing considerable variation, and they are mostly difficult to distinguish. They are nearly always found on trees affected by the longicorn beetles, especially *Clytarlus* and *Plagithmysus*, occasionally on the Kukui tree (*Aleurites*) when the foreign longicorn *Oopsis nutator* is breeding therein. The six described species of *Parandrita* are still more difficult to separate and are imperfectly known owing to the rarity of most of the species. They apparently have the same habits as *Brontolaemus*, but usually occur singly or only one or two examples together, whereas examples of the latter are frequently found in some numbers together.

Laemophlaeus minutus is an imported species and may be found in Honolulu beneath the rind of *Hibiscus* and other trees attacked by other beetles. It is often very common in stores in Honolulu, being numerous in rice and other produce, in company with the usual insects affecting such produce.

Psammoechus insularis and other species of the genus as well as *Monanus* have been found in plants imported from other countries and, doubtless, are all introductions by man, while *Cryptomorpha desjardinsii* comes under the same category. It is an extremely common beetle, very partial to banana plants. The representatives of *Cathartus*, *Silvanus* and *Nausibius* are also importations and of no interest.

Colydiidae.—*Antilissus* is an endemic genus with only one species (*A. aper*). It is an abundant forest insect, and very widely spread throughout the islands, found usually beneath bark of *Straussia*, often many individuals in company. *Glyptoma blackburni*, a Staphylinid, frequently lives with it, and the larvae of both occur with the mature beetles. It shows some variation, but being so different from any other Hawaiian insect, this is not usually noticed. This is the only native Colydiid.

Minthea rugicollis and *Colobicus parilis* have been found in or near Honolulu beneath bark. The latter first appeared about 1900, and became very numerous on the trees killed or injured by fire in the conflagration that took place in cleaning up the city, during an epidemic of plague. The minute beetle *Derolathrus* was first found about the same time, but only in trees on the edge of the road round Mt Tantalus, where house-building was being actively engaged in, and much lumber carried up. It was common, and has since spread to some extent.

Discolomidae.—The single species of *Fallia*, very closely allied to a Central American species, will probably prove to have been introduced. It has been found in the common hard fungus on trunks of *Aleurites* (though not confined to these), and like the fungus itself and the few other beetles found therein is no doubt foreign.

Trogositidae.—Represented only by *Tenebroides mauritanicus* a cosmopolitan and imported species.

Monotomidae.—Represented only by *Hesperobaenus capito*, usually found in the mountains, but once found in Honolulu in decayed sugar-cane. It occurs all over the islands and is sometimes numerous in the inflorescence of *Freycinetia*, in company with foreign Nitidulidae (*Haptoncus tetragonus*) and also with native species of that family. The larvae occur on the *Freycinetia* with the adult.

Nitidulidae.—This family is extremely richly represented by 138 species that are endemic, and a few introduced forms. Excluding the latter there are 13 genera, all endemic, mostly evidently related to one another. Those of which the relationship to the others is doubtful (*Notopeplus* and *Cillaeopeplus*) contain only three or four species in all. A considerable variety of habits is exhibited by the Hawaiian series, so that the allied forms have occupied most situations in the islands, that are affected by these insects in other parts of the world. A few species are terrestrial, living amongst decaying leaves. These are excessively sluggish, and have the size of the eyes reduced and are flightless (*Apetinus explanatus*). The four flightless genera have arisen independently from winged forms, and are not closely allied to one another. So far as at present known they contain few species, only nine in all having been discovered.

The species of *Goniothorax* and *Gonioryctus*, with nine and twenty-four species respectively, show considerable diversity of habits, some frequenting the fleshy inflorescence of *Freycinetia*, others living at the base of the leaves of this plant or *Astelia*, the fresh flowers of which are attractive to the adults; some are found in flowers of Lobeliaceous plants, and breed in the almost liquid, decaying stems of these trees, of *Cheirodendron* and others; some live and breed beneath the bark of hard-wooded trees like *Acacia koa*, and others in decaying tree-ferns. The flightless species of *Nesapterus* have the habits of the latter. The species of *Orthostolus* breed in the semiliquid mess or exudations beneath the bark of Lobeliaceous trees or others. Several are attached to *Acacia koa* and usually a number of examples, from three or four to a hundred or more, are found in company. *Apetinus* is either terrestrial, or found beneath bark of decaying branches. *Eupetinus* contains 24 species, and is allied to the preceding, but fully winged. Many of the species are very common insects and the individuals vary much, so that the specific distinctions are extremely difficult to make out. I spent a great deal of time in the collection of colonies of species of the '*impressus*' group in order to try and understand the limits of variation of these, but owing to apparently distinct species being found together and the variability of all, I was not able to arrive at any satisfactory conclusion. The individual species show a good deal of variation in their habits, breeding in quite different plants. Most of them are attached to dead wood, or to fleshy flowers and decaying inflorescences, and a few to tree-ferns. All are very sluggish, and it is seldom that one is seen on the wing, but possibly they are nocturnal in their activities. The large genus *Nesopeplus* with 32 and *Nesopetinus* with 25 species seem closely connected by some of their forms, and the latter has species evidently connecting with *Gonioryctus*, so that in collecting I always supposed them to be small species of the latter genus. This is the case with the common *N. tinctus*, which is sometimes found with *Gonioryctus* on flowers of *Astelia*. Some of the species of these large genera have habits like those of *Eupetinus* and are found in company with them on Lobeliaceous flowers and *Freycinetia* and also in fruits of forest trees, but others frequent small inconspicuous flowers, e.g. those of *Kadua*, and even the larvae have been found in these. Some are evidently very particular as to the kind of tree they frequent, or are entirely restricted to one kind, but others are much less fastidious. Some breed in rotten stems of tree-ferns. Many of the flower-frequenting species do not breed in the flowers, but only resort to these for food, apparently eating the pollen, with which they are sometimes quite covered. The Ohia flowers, with their abundant nectar seem to be rarely or never visited, though the beetles may be obtained from the dead wood. Many species are very abundant and they are very difficult to determine and will no doubt be much more so, when all that exist have been collected. *Notopeplus reitteri* is an isolated form, attached to the banana plant, in which it breeds, and is widely spread over the islands. It has been taken from tree-ferns, but its occurrence there may have been accidental. The minute, elongate and flattened species of *Cillaeopeplus* are found on various trees, beneath the bark. *C. infimus*, the best-known species, is not attached to one plant, as we have found it breeding in decayed parts of *Pisonia* and on the Urticaceous *Pipturus* and *Urera*.

The four species of *Carpophilus* are all importations, and are either domestic, or found in decaying flowers or fruit. *C. humeralis* and others are sometimes very abundant in rotten sugar-cane stems. Both the species of *Haptoncus* are also found in the latter and also in flowers and fruits, and are certainly introductions. No parasites have been obtained from any of the Nitidulidae, but they are sometimes killed by fungous disease, which is rarely epidemic. I do not remember to have ever found any Nitidulidae in dissecting the native birds.

Histeridae.—The single species of *Carcinops* and two of *Saprinus* are certainly introductions, and the very minute beetles, *Bacanius atomarius* and *confusus*, found only near Honolulu by Mr Blackburn, may also be so. The species of *Acritus* 34 in number are probably all endemic, with the possible exception of *A. insularis*, which, found only near Honolulu, belongs to a different section from all the others. These are all found in dead wood or generally beneath dead bark, especially where there is moisture and decay. It is not known whether they are carnivorous, like most Histeridae, but as larvae of Mycetophilidae and Drosophilidae occur in the same places, it is quite likely that they prey on these. Some of these beetles are flightless, having rudimentary wings, others are fully winged, though we have never seen them expand these. It is usual to find several examples in company and these companies sometimes consist of two (and possibly more) quite distinct species. Owing to the nasty mess in which they often live, I have no doubt I neglected to take nearly as many examples as I might, because they foul and stick to other cleaner insects, and such creatures would be better collected apart or in alcohol. They are not really uncommon and are ubiquitous throughout the islands in the forests. *Aleurites*, *Acacia*, *Pipturus*, and especially *Cheirodendron* are some of the trees that they affect.

Scaphidiidae.—A single *Scaphisoma*, found only in the Waianae mountains of Oahu, represents this family. It is very doubtfully indigenous.

Silphidae.—A single individual of *Clambus* found near the active volcano, to which there is much traffic, alone represents this family. It is probably an introduction.

Trichopterygidae.—I suspect that all the members of this family are foreign, for I have found two species in the town of Honolulu (one in decayed cane and one beneath bark of foreign *Hibiscus*) which are certainly importations. Some doubt may attach to the species of *Ptiliodes*, but two of these have only been found near Honolulu and the other which is found beneath Koa bark in the high forests of Hawaii and elsewhere, also occurs close to Honolulu. The other genera represented are *Actidium*, *Ptinella* and *Trichopteryx*, each with a single species.

STAPHYLINIDAE.—Of the tribe Piestini the genus *Thoracophorus* has two endemic species, one common and variable, ubiquitous over the islands, beneath dead bark of *Straussia* and sometimes on *Bobea*, the other apparently very rare and its habits not known, except that it is also found beneath bark. *T. blackburni* is excessively sluggish and often occurs in numbers together, in company with *Antilissus aper*. The single representatives of *Lispinus* and *Ancaeus* are both foreign, found in or near Honolulu, and, no doubt, introduced by man. *Lispinodes*, an endemic genus, is evidently rich in species, ten having been described by Dr Sharp, but individuals seem to be extremely rare. We have always found these in company with *Thoracophorus blackburni*, or more rarely with species of *Diestota* and *Myllaena*, but have only observed one example of *Lispinodes* to scores or hundreds of individuals of the other genera, on an average. They are always found beneath bark, generally where there is much moisture and decay.

The Oxytelini are probably unrepresented in the native fauna, unless one or other of the species of *Trogophloeus* prove to be endemic or naturally immigrant. From the habits of the Hawaiian species I do not feel sure that these could have been imported by man. On the other hand the four species of *Oxytelus* have certainly been imported.

In the Paederini *Lithocharis vilis* and the two species of *Medon* are probably importations, less probably natural immigrants, but the two *Ophiomedon* probably and three *Nesomedon* certainly are endemic. *N. brunnescens* is found in wet boggy forests under moss or bark and the others are true forest insects, probably of similar habits.

Of the Staphylini the four *Philonthi*, *Creophilus maxillosus*, and *Cafius nauticus* are foreign, whereas the three allied genera *Leurocorynus*, *Xanthocorynus* and *Holocorynus* are endemic genera, together containing only four species, all of which excepting the variable *Leurocorynus cephalotes* appear to be rare insects. I fancy that all are attached to the tree *Cheirodendron*, under the bark of which they live, sometimes larvae and adults together. *Leptacinus flavipennis* is an imported insect, found by Blackburn in Honolulu. Other Staphylinidae which prey on Dipterous larvae in cow-dung, like some of the *Philonthi* above mentioned, have been introduced for economic reasons, but it is not known whether these are established.

The greater part of the Staphylinid fauna is found amongst the *Aleocharini*, *Myllaena* with eleven species, *Oligota* with 28, *Liophaena* endemic and allied to the preceding with three, *Diestota* with 29, and *Eudiestota* and *Eusipalia* endemic and allied to this, with one each. All, or almost all, these species are endemic and of great interest. There are two species of *Atheta*, one imported, the other possibly so, though not known elsewhere. The species of *Phloeopara*, *Xenusa* and *Stenagria* are not likely to be endemic and are very probably importations.

The native *Myllaena*, *Oligota* and *Diestota* all exhibit much variety in their habits, but species of all of them are found in decaying trees beneath the bark, and we have found all together in a single tree Lobelia. Some of the species of *Myllaena* only occur under stones, especially on the edge of streams, others are found in the flowers of *Freycinetia* or Lobeliaceae with *Diestota*, Nitidulidae, etc. Some are only found beneath large decaying logs. The *Oligotae* besides occurring under bark of various trees are some of them specially attached to the foliage of plants, e.g. trees of the composite genus *Dubautia*. *Liophaena* appears to be partial to dry, or moderately dry, dead branches of trees especially *Acacia koa*.

There are a good many common species amongst the three large genera above mentioned, but they require special collecting and the very minute *Oligotae* are easily lost, unless a special bottle is carried for their reception. I have no doubt that I lost many individuals that I came across in general collecting. Some appear to be always found singly or one or two together, while some living beneath bark form little colonies. I once found a score or more of a brightly metallic species beneath a small piece of bark of *Acacia koa* on Kauai, but these must have been lost, as the species is not amongst those described. It is probable that the species of *Myllaena* found beneath logs and on the ground are flightless, excepting those that frequent the margins of the running streams and are very active.

Hydrophilidae.—It is doubtful whether any of the few known representatives of this family are really native, though the genus *Omicrus* was described from the islands, and *Hydrobius nesiticus* and *semicylindricus* also are not known elsewhere. It is noteworthy that two of these species have only occurred on Oahu. *Cyclonotum extraneum* is certainly an imported species. The two species of *Dactylosternum* are also, doubtless, importations. The species of *Hydrobius* are of interest from the fact that the fresh-water fauna of the islands is so very scanty.

H. semicylindricus is a very abundant beetle and I think is sure to be found elsewhere. The fact that it has been found in artificial water-containers led to the suspicion that it was an importation by man, but the occurrence of a second species, far in the native forests, renders it possible that it is a natural immigrant.

Dytiscidae.—A single species of *Rhantus* and one of *Colymbetes* are ubiquitous in the mountain streams. Both exhibit variability and it is doubtful whether they are natural immigrants or whether they are really endemic. On the whole the former is the more probable; a closely allied species of *Rhantus* is found in the far distant island of Tahiti.

Carabidae.—This is one of the most important families of Coleoptera represented in the islands, no less than 210 species having been described, of which one only is at present known from elsewhere.

There is not the least doubt as to the endemicity of any of these species (excluding the introduced *Plochionus pallens*) excepting the other Lebiine, *Saronychium inconspicuum*, which I have no doubt is an importation, and the four species of *Tachys*, which are probably introductions by man. All of these latter are found on the lowlands amongst foreign insects, or else have only occurred in low mountain forests close to Honolulu. Of recent years at least two other Bembidiine Carabids have been imported and become fully established, and also another Lebiine.

Deducting all these, the native Carabid fauna consists of 204 described species all of which are endemic, while a good many additional species, as yet undescribed, are now well known. Restricting our remarks to this endemic fauna, we observe that all the species belong to the subfamily Harpalinae, and to three tribes in this subfamily, viz. Pterostichini, Anchomenini and Bembidiini. These are represented respectively by 76, 92 and 16 described species. The species of Anchomenini are distributed very unevenly in 24 genera, the Pterostichini in four genera (but of one only a single species is known), the Bembidiini in 8, but one of these contains 10 of the 16 species.

Many of the interesting features of the Hawaiian Carabid fauna are detailed by Dr Sharp (Vol. III, p. 175 *et seq.*) and, as I have had occasion to refer specially to these elsewhere, they need not be reconsidered here. The diminished chaetotaxy, predominance of flightless forms, and the relationship of the genera one to another in each group are of particular interest.

The adoption of the chaetotactic characters and those of the wings for the formation of genera is largely responsible for the large number of these that have been described. As Dr Sharp remarks (*l. c.* p. 186) "had I not adopted the condition of the wings and the thoracic setae as a basis for genera, our Hawaiian Carabidae would have appeared as members of only three or four genera. The other structural characters I have used for discrimination are extremely slight. This should be borne in mind, as the picture thus presented of three distinct groups, each consisting of a considerable number of closely allied forms, is fairly correct."

In the Anchomenini the genus *Blackburnia*, represented by only a single species and peculiar to Oahu, is remarkable for its sculpture. It is a heavy-bodied form, less active than most species, and is one of the comparatively few Anchomenines that is found beneath stones.

Deropristus has three species, one each on Oahu, Molokai and Maui. The two latter are not rare and are found beneath prostrate stems of tree-ferns or under logs, but the unique example of the Oahuan species is said to have been found beneath a stone. I once found a single individual of this or an allied form under a stone on a ridge in the mountains near Honolulu, but being called from my room, I left the beetle on the table and when I returned after a short absence, it had been carried off by that household pest, the ant *Pheidole megacephala*, and I was unable to trace it or to find another specimen.

Atrachycnemis is only known from Maui and Molokai, and has the habits of the *Deropristus* of those islands; in fact they are sometimes found in company, but individuals are not numerous. *Anchotefflus* is only known from Kauai and Oahu, a species on each island, and neither seems to be common. *A. gracilis* was found on the rocks in a mountain stream after a heavy spate, and probably lives beneath stones on the margins of these streams. *Pseudobroscus lentus* is only known from near the summit of Haleakala, Maui, where it was found under stones, a few weeks after the disappearance of the snow-cap.

The metallic and rather elegant, punctured, narrow species (four in number) of the genera *Derobroscus* and *Brosconymus* are only known from Oahu, where they are found in holes in the trunks or branches of trees, or beneath close fitting bark. In very wet forests we have once or twice found specimens on dark rainy nights, no doubt lying in wait for their prey, outside their burrows. I suspect that they may be common in the cavities in the higher branches and twigs of Koa trees, as the bird *Paroreomyza maculata* often contains fragments of many examples of these beetles, when it is shot while feeding amongst these branches. *Derobroscus politus* was wrongly recorded from 'leaves' of trees, I should have written 'twigs.'

Anchonymus agonoides was found very locally on Haleakala, inhabiting cavities in the trunk or branches of the Koa. When found, a considerable number of individuals is liable to occur, whereas of *Derobroscus* we never found more than two or three together. The larvae of both these genera were noticed in company with the adults. *Mauna frigida* is one of the most abundant species on Haleakala, Maui, and is found beneath stones in the open country above the forest from 5000—10,000 ft.

There are twelve described species of *Disenochus*, none, at present, being known from Hawaii or Oahu, but on the latter, doubtless, the genus is to be found. They occur beneath bark of trees, or rarely under logs lying on the ground, and several are only found in very wet moss, growing upon tree trunks. A good many of the species are rare or at least difficult to collect. *D. curtipes* in general form greatly resembles *Atrachycnemis*, to which genus I supposed it to belong. It also has the same habits. As a rule the species of *Disenochus* are remarkably constant in their exact habitats, the variable *D. aterrimus*, however, exhibits some inconstancy in its choice of these. *Chalcomenus* with three species occurs on most of the islands; the form on Hawaii seems to be practically the same as the Molokai species. It is remarkable for the fact that it roams about in the daytime, though usually this is only noticed in deep dark gulches. In more exposed and open situations many examples may be found hidden beneath stones or elsewhere, but none seen at large till after nightfall. The large beetles of the genus *Barypristus* are confined to the open country of the high mountains of Maui and Hawaii above the forest line, or on the edges of the region of large timber. Both species are found beneath stones, *B. rupicola* almost entirely so, but *B. incendiarius* on Hawaii, on the edge of the forest-belt, also occurs low down under bark of Koa trees, sometimes even beneath the level of the soil. Both are common beetles in suitable localities. *Baryneus sharpi*, differing from the preceding in its well-developed wings, is of far more arboreal habits and may be obtained high up in trees from beneath bark, usually of *Acacia koa*; but it is not restricted to that tree. Very rarely it is seen at large during the daytime, ovipositing in the chinks of the Koa trees. *Colpodiscus* contains two species, one of which is common to Maui and Hawaii, and is often extremely abundant, flying in numbers to light at night. On Hawaii it is usually found amongst dead leaves or fallen stems of tree-ferns, or beneath logs, but in the Iao valley it was found beneath stones or shingle on the banks of the stream, where *C. lahainensis* also occurs. Once we found a specimen devouring an *Oniscus*, a creature usually avoided by Carabidae, so that where it abounds under stones, ground-beetles are usually absent. *Prodisenochus terebratus* is found only on Haleakala, Maui, beneath or in decaying logs and appears to be rare. It is sometimes in company with *Atrachycnemis*, but is I think rarer than the latter. *Apteromesus maculatus* is restricted to Kauai, where it is common locally. *Mysticomenus* with two closely allied species is only known on Oahu. *M. mysticus* is said to occur beneath stones, but *M. tibialis* is common under bark in both mountain ranges.

The genus *Colpocaccus*, with six described species, contains some of the commonest Hawaiian Carabids, and most of the species are excessively closely allied, so that I suspect the number is liable to be reduced. They all are attracted by light at night in the forest region, to which they are restricted. They are remarkable for the inconstancy of their habits, not one of the forms being restricted to a special habitat. They may be found beneath stones, under or in logs, under bark of trees, in the stems of tree-ferns or amongst the dead fronds, in decaying vegetable matter on the ground, at the bases of leaves of *Freycinetia*, etc. and in other situations. Colonies even of hundreds of individuals are sometimes found together, and sometimes other rarer Carabidae are found mixed in these colonies. At night they may be seen at large on trees, or running about on the margins of mountain streams or on the ground beneath the forest trees. The fifteen species of *Atelothrus* are mostly found on the neighbouring intermediate islands of Maui, Molokai and Lanai, only one having been found on each of the islands Hawaii and Kauai, and that from the former island is of somewhat doubtful status (as to whether it is not a sport of *Mesothriscus* or *Metromenus*) and that from the latter is an aberrant form. Though none are recorded from Oahu, I have for some years known two remarkably distinct species from this island. Some of the species of *Atelothrus*, e.g. the very abundant *A. erro*, are not constant in their habits, since they are found both under stones, etc. on the ground and beneath bark of trees at a considerable height from the ground. Others like *A. platynoides* and *transiens*, I believe, have only arboreal habits. The fourteen species of *Mesothriscus* and twenty-six of *Metromenus* in general resemble *Atelothrus* in their habits, some being arboreal either living beneath bark or in moss or in cavities in rotten wood or in tree-ferns, or on the ground, in or beneath logs of wood, and but rarely under stones. A few species in both genera are found in wet forests by day on the flowers of *Astelia*, and some, like *Metromenus mutabilis*, hide in numbers at the bases of the leaves of this plant or (like *M. palmae*) of *Freycinetia*. Occasionally at night we have seen some of the Anchomenine Carabidae devouring caterpillars, and it is probable that these form a large part of their *pabulum*. Their fondness for *Acacia koa*, which so generally is attacked by caterpillars of *Scotorythra*, leads me to suspect that this genus supplies many of them with food. The beetles themselves are in some cases very long-lived, even under unnatural conditions in captivity, and I have been struck with the fact that while the larvae of many of them are found in the same situation as the adults, the latter generally are much more common. The species of *Mecostomus* and *Mecomenus* are not well known, but they are apparently terrestrial species.

That the Oahuan bird *Oreomyza maculata* apparently hunts specially for the Carabidae of the genus *Derobroscus* has been mentioned above, and I have found remains of *Colpocaccus hawaiiensis* in dissecting the rarer bird *Viridonia* on Hawaii, and this latter genus of beetles and some allied genera in other birds. *Metromenus*, *Colpocaccus* and other of the genera emit an unpleasant odour, and when a colony of *C. tantalus* is disturbed, under certain conditions of weather, the vapour given off becomes easily visible, and in ammonia gas produces dense white fumes.

Generally speaking one may say that of these Carabidae those species with the most diverse habits are the most abundant, but a few that are more constant in habits, e.g. *Metromenus palmae* and *M. mutabilis*, are also very common. It seems clear that the scarcity of some species is due to the fact, that they are very particular as to the condition of their habitat, and that these conditions can rarely be found. Such species cannot but be individually weak, even though they are generally present, when the right conditions occur. Others like *M. palmae* and *mutabilis* above mentioned, though restricted to certain environments, find the right conditions commonly. Yet other species, which apparently are rare, and yet, so far as one can judge, affect conditions that are commonly met with, may be thus rare because the conditions which are really suitable are not common, but we are not able to distinguish between the suitable and unsuitable.

The four genera of Pterostichini cannot at all be distinguished from one another by their habits, but there is much difference between some of the species in this respect. Generally speaking they agree in these with the Anchomenini. Many are arboreal being found only under bark, or moss, or in dead branches of growing trees, and usually those of terrestrial and arboreal habits are quite constant in these habits. Some of the ground-frequenting species are not uncommonly found in decayed stems of tree-ferns, and a few, like *Metrothorax deverilli*, are found beneath bark or moss on trees, in hollow decayed stems, and amongst decaying leaves upon the ground. Quite a few of the species occur beneath rocks or stones, chief amongst which is the extremely abundant *Mecyclothorax montivagus* of Maui, replaced on Hawaii by *M. pele*, of which some specimens seem intermediate in appearance. The Pterostichine beetles are almost ubiquitous throughout the forests of the islands, excepting where these are invaded by the introduced ant *Pheidole megacephala*, and those of Kauai, where not a single species has been discovered. On Oahu they are much more poorly represented than on the other islands with equal forest area. On the highest mountains a number of species are found in the open country above the forest-belt, but not one (nor any other endemic Carabid) is known below the forest, since every moderately damp situation is there occupied by the foreign ants. Probably all the species are nocturnal in their activities, since only on the rarest occasions has an individual been seen walking in the open or on the leaves of trees in the daytime. Apart from the question of the thoracic setae, some of the species are notably variable and varietal differences are sometimes considerable between individuals actually taken in company. A few species are remarkable for the peculiarities of their sculpture, as also are a good many of the Anchomenine series. Occasionally, as with the latter group, remains of Pterostichines have been observed in the native Drepanid birds.

The Bembidiini differ considerably from the other two groups of endemic Carabidae in the fact that no arboreal forms are known, though individuals have been met with on rare occasions in decayed parts of fern stems, and further, many of the species, that inhabit moderately damp situations, are found roaming about in full daylight. Occasionally we have noticed specimens feeding on minute larvae of other insects and once a number of individuals together were observed feeding on a dead hive-bee. The flightless *Gnatholymnaeum* was found in or beneath large stems of tree-ferns and is only known from Kauai, where the Bembidiine fauna is most richly developed. *Nesolymnaeum*, also containing only one species, has, I believe, similar habits, but is fully winged. It is widely distributed occurring from Oahu to Maui, though rare. *Bembidium teres* is already known on all the islands from Kauai to Maui and is sometimes numerous amongst the small stones or shingle on the edge of mountain streams. *B. pacificum* is more often found amongst dead leaves and is fairly common locally on Oahu and occurs on Kauai. *B. molokaiense* another winged species is found from Kauai to Maui. *Nesocidium* as a genus is only distinguished from some of the species of *Bembidium* (*B. molokaiense*) by its vestigial wings. *N. lacticulum* is found from Kauai to Maui or with the same range as *B. molokaiense*, suggesting the idea that it is a dimorphic form of this, as does its structure. The other species of *Nesocidium* are at present known each from only one island, but they have mostly been so rarely collected, that not very much weight can be attached to this. The genera *Atelidium*, *Metrocidium*, *Nesomicrops* and *Macranillus*, each monotypic and endemic, are only known from Kauai. Their habits are the same as those of *Nesocidium*.

Excepting that two species of Hawaiian Carabidae are referred to the widespread genus *Platynus* and five to the ubiquitous *Bembidium*, all the certainly endemic species are placed in genera that are also endemic.

Review of Lepidoptera.

Up to the present time[1] 764 species of this Order have been described or enumerated from the main islands, but of these at least 61 may be considered as foreign. Many of the latter are obviously importations by man, while a minority are equally certainly natural immigrants from other countries; a few cannot with certainty be assigned to either of these classes, but almost certainly belong to one or the other. Seven hundred species, or 92 per cent. of the Lepidopterous fauna, are therefore endemic.

Of all the families of the Order twenty only are represented in the islands, and three of these contain each only one species and that certainly imported by man. The Pierid, *Pieris rapae* was imported with cabbages from California some 12 years ago; *Meliphora grisella* (Galleriadae), no doubt, with honey bees; *Ethmia colonella* (Oecophoridae), appeared in the islands a good many years ago, but is known to have been of comparatively modern introduction. Other two families, Nymphalidae and Lycaenidae, are represented by only one endemic species each, supposing *Lycaena blackburni* to be truly endemic, which is by no means certain.

If we leave the foreign element in the different families out of consideration, we find that nine only contain fifteen or more species. These are the Caradrinidae with 34 species, Hydriomenidae 17, Selidosemidae 39, Pyraustidae 172, Gelechiidae 41, Hypomoneutidae 270, Carposinidae 33, Tortricidae 47, Tineidae 15. Consequently nine families contain no less than 668 of the endemic species or 95 per cent. of the whole.

The 764 species of Lepidoptera are distributed in 117 genera, of which 37 are supposed to be endemic. Generic endemicity is much greater in the smaller moths (i.e. in the Tortricina and Tineina together) than in the aggregate of other great groups or superfamilies, in fact it is nearly twice as great in the former, which have 24 of the 58 genera endemic. The larger moths and butterflies on the other hand have only 13 endemic genera of their total of 59. Thirty-three genera contain only apodemic species, these being either introductions by man or in some cases natural immigrants, while thirty-three genera, though themselves apodemic, contain only endemic species. Fourteen genera contain a mixture of endemic and apodemic species. The 61 foreign species are therefore distributed in 47 genera, or average about 1·3 to a genus, while the 702 endemic species are placed in 84 genera, an average of 8·3 to each genus.

[1] In this account the families and genera adopted are as in the Systematic part of this work. In a few cases the number of species is slightly changed to bring this up to date—June 1909.

Many of the endemic genera, that contain a single, or only a few species, are clearly offshoots from other of the larger endemic genera, or as one might say, they are species of these genera, which have diverged more widely in structure than the average. Such are *Sisyrophyta*, *Nesochlide*, and *Acrodrepanis*, derivatives of, or at least of the same original ancestors as, *Scotorythra*, the formation of such genera having no doubt taken place within the islands. Similar groups are *Mestolobes*, *Promylaea*, *Orthomecyna* and *Protaulacistis*; *Thyrcopa*, *Catamempsis*, *Psychra*, *Ptycothrix* and *Hodegia*, and others.

While therefore the apodemic genera are usually very distinct or remote from one another, the endemic are often closely allied to one another, in such a way as to form aggregates of several allied genera, these aggregates being generally remote from one another and more nearly corresponding to the apodemic genera than do the individual genera composing them.

These preliminary remarks will show the restricted nature of the indigenous Lepidopterous fauna, and from how few original ancestral immigrants it might have been derived.

CARADRINIDAE.—There are five genera, three, *Heliothis*, *Caradrina* and *Spodoptera*, containing only foreign species, and two, *Agrotis* and *Leucania*, with both endemic and apodemic species. The two very widely distributed *Agrotis*, *A. ypsilon* and *A. saucia*, though they may have reached the islands by natural means, are equally likely to have been imported in their earlier stages by man. This is also true of *Leucania unipuncta*. This latter and *A. ypsilon* both occurred to Blackburn during his residence in the islands, but *A. saucia* is apparently a more recent introduction. In the winter months it is often common in gardens in Honolulu, as well as being abundant in mountain localities at other seasons, yet it would appear not to have reached the islands up to the time of Blackburn's departure.

Apart from all these foreign members, *Agrotis* has 26 and *Leucania* 8 endemic species. Meyrick considers these endemic *Agrotis* as probably of American origin and forming a group of allied species, but Hampson scatters them in five genera (*Feltia*, *Epipsilia*, *Agrotis*, *Agrotiphila* and *Euxoa*) these being themselves all of wide distribution. Similarly the eight endemic *Leucania* are referred by Hampson to three genera, *Cirphis*, *Eriopygodes* and *Hyssia*. Meyrick recognizes two "quite independent and dissimilar groups," the first four species forming an endemic group of unknown origin, while the others are allied to *L. unipuncta*. It is the first of these two groups that contains the species referred to *Eriopygodes* and *Hyssia* by Hampson.

Heliothis armigera is no doubt a natural immigrant, as also are the two species of *Spodoptera*, while *Caradrina reclusa* is a recent importation (first appearing in 1902 but now fully established) and the other *Caradrina* (*C. examinis*) will also probably prove to be foreign.

Leucania euclidias is one of the most variable of Hawaiian moths; some of these varieties are figured in Volume I. pl. 3. The most extreme varieties are found at the same time and place, but it would appear that in some localities the species exhibits a much smaller proportion of extreme aberrations than in others. It is extremely abundant in the wet woods of the Hilo and Puna district, where *L. niphadopa*, *compsias* and *anthracias* are found with it, but in much smaller numbers. There the caterpillars are common on ferns, and the pupae in decayed wood or beneath moss. All of these species are attracted by light and in some localities *L. euclidias* appears at all hours, but on the lower edge of the forest at Waialua on Oahu, we observed on several occasions, that no more than a straggler or two were ever attracted until 11.30 p.m. or later, when scores would arrive in quick succession, till hundreds in all were present. No matter how favourable the earlier hours had been for the capture of other moths, *L. euclidias* never put in an appearance in numbers until near midnight, and striking varieties were in small proportion to the more usual forms, certainly far less numerous than in some of the wetter districts. All the species of this group are true forest insects and most abundant in wet forests. During the daytime the moths hide amongst dead leaves and are sometimes very numerous in the masses of dead fronds that remain attached to tree-ferns.

The remaining group of *Leucania* contains species very similar to the widely spread *L. unipuncta* which are less special in their habitats. *L. amblycasis*, even in dry localities, is not infrequently found on the lowlands in company with *L. unipuncta*. In the forest region it is much attracted by the flowers of *Metrosiderus*, of which a small tree may yield hundreds of examples of this moth. When disturbed they fall to the ground and make no attempt to fly, being gorged with the copious nectar of the flowers. The moth has great powers of flight and we have known it attracted to the lights of an interisland steamer, when this was in midchannel. This and *L. pyrrhias* in the larval state feed on grasses, attacking imported species and sugar cane, but the natural food of the latter species is more probably the common sedge *Baumea meyenii*, in the debris at the roots of which Swezey has found it hiding. The caterpillars of this *unipuncta* group of *Leucania* are very different from those of the *euclidias* group.

The endemic species of *Agrotis* are of diversified habits, some being true forest insects, while others are to be found rather in the open country, whether this be at low or high elevations in the mountains. *A. microreas* flies freely in the morning sunshine over the low growth of *Vaccinium*, *Cyathodes* etc., which covers the ground in open, upland forest-land of Hawaii. At certain seasons we have observed it on the wing in great numbers, reminding us very strongly by its flight and appearance of the well-known European *Charaeas graminis*.

Some species are littoral or sublittoral and attached chiefly to dry sandy localities. *Agrotis cremata* and *photophila* are notable examples. Others, such as *A. arenivolans* and *dislocata* frequent the coastal districts, lowlands and lower mountain elevations and then reappear above the forest-line or in extensive open places in the forest. *A. dislocata* is one of the commonest species, and its caterpillar sometimes does much damage to farm produce, stripping the potato, tomato and many other plants of their foliage, as well as gnawing through the stems. In this work it is frequently aided by the caterpillar of the very dissimilar moth *A. crinigera*, both being truly 'cut-worms' and in the larval state remarkably similar to one another. Sometimes one and sometimes the other is the most injurious, but *dislocata* appears to thrive at higher altitudes in the mountains. On the uplands of Hawaii, as at Waimea, where *A. dislocata* sometimes does much injury to cultivated plants, the moths are noticeably different from those taken on Oahu, Molokai, etc. They are greyer or whiter in appearance and this gives them a distinctive look, when series of examples are placed side by side. These two injurious species are a favourite food of the golden plover, which catches the moths, as well as their caterpillars.

On the high mountains above the forest-line and in open forest *A. crinigera* seems to be replaced by allied forms, *A. mesotoxa*, *epicremna* and *baliopa*, which never descend to the open country below the forest. Similarly, at great elevations, *A. dislocata* is replaced by *A. aulacias* on Maui and on Hawaii by an undescribed species.

At present little is known as to the parasites of *Agrotis* and *Leucania*, except that some of the species are much destroyed by the Tachinid *Chaetogaedia monticola* and to a lesser extent by *Frontina archippivora*.

A species of *Enicospilus* has been bred from *A. dislocata*, and it is therefore likely that the Ophioninae will be found to attack many of these caterpillars, as they are partial to the endemic *Leucaniae*.

All the endemic *Agrotis* have great powers of flight, and many of them rise so readily in the daytime, as one walks along, and travel at such speed with the wind, that even where individuals are very numerous, it is often difficult to capture many specimens. This is especially the case with those that frequent the open and exposed parts of the higher mountains, where strong winds are prevalent. Many of the species are very strongly attracted by the juices exuding from decaying fern leaves, and also by artificial light, while some visit the flowers of *Metrosiderus* and sandal trees, and no doubt others.

Heliothis armiger, though a common insect, does not appear ever to attain here the extraordinary abundance that it reaches in other countries. The larvae, often lying exposed in the flowers of *Sida*, or on other plants, are very subject to the attacks of the two Tachinid flies mentioned above, as being parasites of *Agrotis*, and in some seasons nearly all the specimens found are parasitized. The colour variations of the moth are numerous, and are not of local occurrence. Thus eight examples taken together on Molokai varied from the palest yellow form to the darkest suffused one, not two individuals being alike. On the dry lowlands *H. armiger* is rare, except during the winter months, or when *Sida* and other lowland plants spring up afresh after heavy rains.

The two species of *Spodoptera* are doubtless natural immigrants, *S. exigua* being practically cosmopolitan in warm regions, while *S. mauritia* is one of the few insects that have always been well known to the natives, on account of the periodical abundance of its larvae. These are truly 'army-worms' marching over great areas of pasture land and devouring all the herbage on their march. Of late years these great armies have been much less frequently noticed, though formerly of annual occurrence at the season of the growth of fresh grass. There is no doubt that this diminution of the ravages of the grass army-worm was due to the excessive multiplication of the imported Indian mynah bird (*Acridotheres tristis*), great flocks of which visited the pasture lands to feed on the caterpillars. Of late years it would appear that the mynah bird has become less numerous, owing to the failure of lantana berries, which formed its chief supply of food throughout the year, and it is said that, coincidently with this decrease, the army-worm has again occasionally become conspicuous in some pastures. Previous to the great multiplication of the mynah bird, this *Spodoptera* was a favourite and important food-supply of the golden plover during the winter months. It is well known that, when feeding on the hordes of caterpillars, these migrants from Alaska arrived at their finest condition, before leaving the islands for their distant breeding grounds.

Of the two species of *Caradrina*, *C. reclusa* is a recent importation, no doubt from Fiji, as we have seen its larvae on consignments of plants from those islands. It was first found in Honolulu in 1903 and soon became common, and extended its range to other of the islands. *C. examinis*, once found on the island of Hawaii, is probably also a foreign species.

Plusiadae.—The two genera *Simplicia* and *Adrapsa* are each represented by an introduced species, both of them occurring in Fiji, and we have found the larvae of both swarming on plants imported from that group. The *Simplicia* was imported long before the *Adrapsa*, which was not noticed until after 1902.

Nesamiptis, with two species, was described from the islands, but I believe exists in tropical Australia. One of the species (*N. obsoleta*) is extremely common and most variable in colour and pattern of markings. Its caterpillars feed very freely on the imported 'Hilo' grass. The other, *N. plagiota*, is much more local, though sometimes common, and appears to vary very little as compared with its congener. *Hypenodes*, with seven species, has one which is very widely distributed and abundant, and also very variable (*H. altivolans*). It is freely attracted by light and to sugared trees and may often be observed in great numbers flying at dusk in marshy places in the mountains amongst sedges. Most of the other species frequent very wet forests, and are much less numerous and less commonplace in appearance.

Of the two species of *Cosmophila* one is probably introduced, as we have found its caterpillars on plants brought from Fiji. Both exhibit much variation, but in the case of the foreign *C. sabulifera*, variation is local or irregular. In one instance a number of caterpillars, taken on a native *Hibiscus* (?) in a mountain forest, produced a very variable series of adults, including some remarkable aberrations. On another occasion a very large number of moths bred from caterpillars, that were injuring a fine hedge of a foreign *Hibiscus*, showed no remarkable varieties. Sometimes the foliage of the 'Hau' tree (*H. tiliaceus*) is much injured by these caterpillars. *C. noctivolans* is sometimes found commonly in dry places amongst *Sida*, on which the larvae feed, as well as on some of the plants affected by *C. sabulifera*. The latter is much parasitized by the common Tachinid flies, *Chaetogaedia* and *Frontina*, so that hedges of *Hibiscus*, very badly defoliated, may become entirely freed from caterpillars by their means.

Of the two species of *Hypocala*, *H. andremona* is, doubtless, a natural immigrant, these insects being endowed with great powers of flight. *H. velans*, considered by Meyrick as a variety of *andremona*, is, I think, clearly a distinct species and presumably derived from the latter. It appears to be much more numerous than *andremona* in most parts of the islands. In the daytime it often secretes itself amongst the lava, which is piled up to form walls in various parts of Hawaii, and from these it is very easily disturbed in the daytime. It also frequents the caves and cavities in the sides of precipitous gulches, issuing from these in great numbers, as we have noticed on Molokai and elsewhere. It freely enters houses, much more often than *H. andremona*. Both feed on *Maba sandwichensis*, and their earlier stages have been studied by Swezey, confirming their distinctness. Although most abundant on the lowlands and lower mountain slopes, we have noted the occurrence of *H. velans* in a well-known cave at an altitude of nearly 9000 ft. on Haleakala.

Plusia chalcites and *P. biloba* are, no doubt, natural immigrants, the former ubiquitous and very numerous, often indeed injurious, being polyphagous, the latter most partial to the uplands and generally scarce. *P. chalcites* occurs also on Midway Island. In the wettest districts of the islands the caterpillars are sometimes destroyed wholesale by epidemics of a fungous disease, while another fungus attacks the moth. The pupae are much parasitized by the endemic *Echthromorpha* and the imported *Chalcis obscurata*, and the caterpillars by the Tachinid flies. But for these restraining agents, *P. chalcites* would prove one of the worst of pests. *P. pterylotis* is a very remarkable endemic species of rare occurrence, but widely distributed, as it has been found on Oahu and Hawaii. It is replaced on Maui by an allied, but very distinct species. These endemic forms have no connection with the apodemic ones named above, nor are they apparently closely related to any known species of the genus. The cause of their rarity is not known, but, no doubt, they will be found to be heavily parasitized by the *Echthromorpha*, which is always very numerous in the localities where they occur.

HYDRIOMENIDAE.—The greater number of the species belong to the genus *Eucymatoge*, with 10 described forms and, doubtless, others to be discovered. *E. monticolans* is ubiquitous throughout the forests, and is remarkable for its great variability. Extreme varieties are often found in company, but in some localities (notably, e.g., on the summit of the small island of Lanai) there is a tendency for some particular variety to predominate or become conspicuous. Some of the variations have been figured in the systematic portion of this work. The Hawaiian species, like others, rest during the daytime with outspread wings on the trunks of forest trees. *E. monticolans* on various trees and *E. craterias* on *Acacia koa* are very often obtained by examining the trunks. The latter also rests on the surface of rocks. One or two species are found above the elevation of the true forest-belt, and some are restricted to very wet woods. *E. monticolans* has been bred from a full-grown larva found on *Metrosiderus polymorpha.* The species of *Xanthorhoe* appear to be all rare insects in the imaginal state, and their earlier stages are not known. *X. insularis* is found above the forest-belt on Haleakala, Maui, from seven or eight thousand feet above sea-level upwards. The other three species are forest insects. *Progonostola cremnopis*, forming an endemic genus, is widely distributed, and occurs on Oahu, as well as on the windward islands. Near Honolulu it may be found resting on tree-trunks or the stems of tree-ferns on Mt Tantalus, and on the decomposed lava of steep cliffs at Nuuanu Pali. It bears a considerable superficial resemblance to *Xanthorhoe caustoscia.* The single species of *Dasyuris* was found on the upper skirts of the forest on Haleakala, Maui, where it occurs periodically in extraordinary numbers, flying by day. On several visits to the locality not a single example has been observed, but on one occasion it was swarming over a limited area. Though not a rapid flier, it was not very easily captured, being expert at keeping just out of reach. The smaller *Hydriomena aphoristis* appears to have similar habits, being also a day-flier, though also attracted by light at night, but is usually seen singly, and we have never seen it in numbers. It has so far only occurred on Hawaii.

Selidosemidae.—The Selidosemidae with about forty known species, and, doubtless, others undiscovered, are a most important element of the Lepidopterous fauna. Most of these are absorbed in the genus *Scotorythra* with 34 species, and the other four genera may be looked on, for the most part, as merely more modified forms of the large genus. All five genera are endemic. The forms included in *Scotorythra* itself are of varied structure, as if tending to break up into several groups or genera, and these distinctions in the adults appear to be to some extent correlated with corresponding differences in larval characters. The smaller species of the genus, belonging to the group of *S. corticea*, for instance, have a characteristic appearance and pattern (or form of the second line of the forewings), tending at the same time to differ in character of neuration, and also in the length of the tibial spurs from the others. Some of them, and perhaps all, rest at times with spread wings, Boarmia-like, on the trunks of trees. On the other hand the numerous species, large and small, of the *S. rara* group, rest, Anisopteryx-like, with the wings unspread, so as to form an elongate triangle, creeping into holes in trees or beneath bark, or lying hidden amongst masses of dead fern leaves during the daytime. *Sisyrophyta* is remarkable for the secondary sexual characters of the male, the wings being more or less distorted in this sex by a special clothing of the under-surface, which in *S. gomphias* has the appearance of a dense felt. *Nesochlide* has a group of specially modified scales on the underside of the forewings in the male. The great *Acrodrepanis* and small *Tritocleis* lack the modified hind tibiae and the characteristic hair-pencils of the other forms.

Some of the species of *Scotorythra* are amongst the commonest of moths, and some have been able to adapt themselves to great changes in their environment. Thus *Scotorythra rara* and *brachytarsa* sometimes become very numerous, their caterpillars feeding on the introduced guava trees, in localities whence all native vegetation has disappeared. We have even found caterpillars of this genus feeding on the strong-scented imported Lantana. *Sisyrophyta gomphias* can also maintain itself away from native vegetation.

Many of the species of *Scotorythra* are polyphagous, but even these seem specially to favour certain plants. *Acacia koa* is attacked by numerous species, and certain of these become locally and periodically so numerous, that great areas of 'Koa' forest are entirely denuded of their phyllodes. When this denudation is long continued we have known trees to be entirely killed, not perhaps altogether directly owing to the attacks of the *Scotorythra*, but because, after a sickly condition had been induced by the denudation of foliage, other insects (e.g. the longicorn beetles of the genus *Plogithmysus* and the small, boring Scolytidae) joined in the attack. *Scotorythra idolias* on Hawaii and *S. paludicola* on Maui were responsible for two of the most severe attacks that we have witnessed. Native birds attracted in thousands by the abundance of this, one of their favourite foods, were gorged to repletion, and the starving caterpillars formed writhing masses on the ground beneath the tall Koa trees. The dropping of excrement from the trees on the dead leaves beneath made a rattling noise as of a hailstorm. In one instance it was noted that these pests of caterpillars were destroyed by an epidemic fungous disease, which attacked the full-grown larvae after their descent to the ground for pupation, as well as the pupae themselves.

In open spaces in the forests at nightfall one may see large numbers of the moths flying slowly overhead and often out of reach, traversing these spaces and all or nearly all travelling in the same direction. Sometimes they congregate in hundreds within some hollow tree-trunk or amongst the pendent masses of dead fronds of tree-ferns. In some cases all the individuals so congregating are males, even in one case where several hundreds of examples were taken together. Many of the species are attracted by light, in some of these the males and in others the females are much more numerous. Thus but one female of *Nesochlide epixantha* was attracted amongst scores of the other sex. The males of this pretty species also freely visit the flowers of *Metrosiderus*, and they are abroad on the most windy nights, to which, no doubt, is due the fact that one occasionally meets with a straggler on the lowlands, and even in the town of Honolulu. The female of this species is remarkable in that it is occasionally found flying freely in the sunshine.

No doubt, formerly, numerous species have existed on the lowlands, but these have mostly disappeared owing to the attacks of foreign predaceous insects, especially ants. In very dry localities, where that destructive little ant *Pheidole megacephala* is unable to exist, or is hardly present, species of *Scotorythra* still flourish. This is the case with *S. paratactis*, the caterpillars of which are very numerous on the scanty vegetation that grows near the coast on the driest parts of the west side of Oahu. The exposed caterpillars of this species would be quickly exterminated by *Pheidole* in most parts of the coastal region of this island.

The caterpillars of some of the species of *Scotorythra* appear to be nocturnal in their feeding habits, and during the daytime hide beneath the bark of the trunks of the trees, on whose foliage they feed. In this situation considerable numbers may be found at rest, ranged side by side. They form a most important part of the food supply of the endemic birds, and are supplied by the parents to the young of nearly all the species, while they are a favourite food of many adult birds as well. On the other hand they are very little attacked by the many species of wasps of the genus *Odynerus*, and it is most remarkable that, since these do occasionally store them up in their cells as food for their young, they should not more often avail themselves of so abundant a prey, when more favourite caterpillars become scarce or fail. The ubiquitous bug, *Oechalia grisea*, also destroys great numbers of the larvae of many *Scotorythra*. The variation in colour and markings of many of the species of *Scotorythra* (as well as of *Nesochlide* and *Acrodrepanis*) is very great, and some idea of this variability may be gathered from the figures accompanying the systematic descriptions in this work. In most species, that show much variation, the extreme varieties are taken in company. It is not known whether difference in the food plant is to any extent the cause of variation, but it is certain that it is not so in some cases, where variation is very great, as several species have been tested in this respect. It is very noticeable how frequently species, that are quite distinct, yield similar varieties, and a character which appears as a variation in one or more species may be a constant character in another. As an example of this one may mention the presence, as a constant character, or merely as an infrequent variation, of a conspicuous pale costal streak. In some species the males and in others the females appear to be more subject to variation, and some, of which large numbers have been examined, exhibit very little variability.

The pupae of *Scotorythra* are very commonly found when one is searching for other insects, under wet moss, in damp rotten wood, under logs, and in other situations. Most of them, however, as well as the caterpillars, are difficult to breed, when removed from the wet mountain forests to the lowlands, even though great pains are taken to keep them as nearly as possible under natural conditions. Some of the large species have been observed laying their eggs in the bark of trees, the ovipositor being of great length when fully protruded.

SPHINGIDAE.—Only six species of this family are at present known, and of these three are known elsewhere, being natural immigrants. The widely distributed *Sphinx convolvuli* is more abundant than its congener, *Sphinx celeus*. The latter is usually found in the larval state, feeding on the tobacco plant, or on some of the species of *Solanum*, while the former is not only extremely common on many species of *Ipomoea*, as well as on other plants, as a caterpillar, but is also an abundant moth, readily attracted by flowers or electric lights. In the morning large numbers may sometimes be found attached to the flowers of the wild ginger, which they have visited during the night, and from which they have been unable to withdraw their proboscis. Examples so caught are often devoured by ants during the course of the day. The caterpillars of *S. convolvuli* are very variable in colour, and all sorts of varieties of these may be found at the same time and place. Sometimes they do considerable injury to the sweet potato (*Ipomoea batatas*). The eggs are subject to the attacks of the small parasite *Pentarthron*. The third immigrant, *Deilephila lineata*, is also a most abundant species, and ranges to much greater elevations than the species of *Sphinx*, for we have found the caterpillars entirely stripping certain plants at a height of 5000 ft. in the mountains, and at still greater altitudes. In dry districts near the coast it appears in abundance periodically, after or during the rains, and is polyphagous. The moth may be seen on the wing sucking the blossoms of lantana or other tubular flowers, even during the hottest sunshine, though usually more active towards night.

Three closely allied endemic species of *Deilephila* are of more interest. They are chiefly forest insects, though they range over the dry forehills down to the coast. *D. wilsoni* (*pyrias*) is at present known only from Hawaii, where it is generally distributed, the polyphagous caterpillars feeding on many forest trees of different families. In wet districts the moth is freely on the wing at all hours of the day, visiting the flowers of *Metrosideros*, as well as those of cultivated plants, nasturtiums, canna, etc. In drier localities it flies more freely at dusk. We have seen hundreds together rising straight up from the rough lava flows, that intersect the dense forests of the Hilo district of Hawaii, till they reached the height of the tall tree-tops on either side of the flow. *D. calida* is generally distributed on Oahu and Molokai and its caterpillar is polyphagous like that of *wilsoni*. It varies much in markings, sometimes having a pair or a number of eye-spots present, and these eye-spots may differ in number on either side of the body, and in different individuals may occupy entirely different segments. In many examples they are altogether wanting. Sometimes they are present only towards the head end of the caterpillar, sometimes only on the segments near the caudal extremity. The moth itself exhibits a good deal of variability, as does *D. wilsoni*. On Hawaii in addition to the latter there exists a second species or local race, much more nearly allied to *D. calida*. No representative of these has yet been taken on Kauai, but caterpillars similar to those of the others have frequently been found there, so that at least one additional species is to be expected, unless these caterpillars prove to belong to the remarkable green-coloured *D. smaragditis*. Probably other species allied to *D. calida* remain to be discovered. We have found many larvae of the last named marked with black scars, showing the attack of some parasitic or predaceous insect, but nothing was bred from these.

PIERIDAE.—*Pieris rapae* first appeared in 1897, having been, doubtless, introduced with cabbages from California. On the lowlands it abounds chiefly during the winter months and becomes to a considerable extent injurious. All the butterflies produced are of the European summer form, there being no seasonal dimorphism. In dry hot coastal districts the eggs are laid very freely on *Capparis sandwichiana* of the Capparidaceae, so that the butterfly is often very abundant in localities, where, at first sight, no suitable food-plant appears to be present. The eggs of *Pieris* are in some places much destroyed by the little ant *Pheidole megacephala*, and the caterpillars are preyed on by introduced wasps of the genus *Polistes*, which strip and carry off portions of them to feed their young. It would appear that as *Polistes* increases in numbers in the summer, after new colonies have been started by the hibernated females, the *Pieris* becomes much less numerous, while as soon as the nests of the wasps are deserted and the state of hibernation is begun, the butterflies increase very rapidly and their caterpillars become very troublesome. The well-known parasite *Pteromalus puparum*, which has several times been imported in great numbers, as an enemy of the *Pieris*, is apparently unable to establish itself here.

NYMPHALIDAE.—*Anosia crippus* is no doubt a natural immigrant, which has established itself in the islands since the introduction of the milk weed, on which it feeds, by foreigners. It is found wherever the food-plant grows, and, being a very powerful flier, often in places far distant from this plant. Though very common, it is not, as has been reported by a visiting entomologist, the commonest butterfly in the islands, being much less numerous, for instance, than *Lycaena boetica*. It is not very variable, though once or twice we have noted melanochroic and albinoic examples on the wing amongst the large numbers seen. The caterpillars are attacked by the common Tachinid fly, *Frontina archippivora*.

Vanessa cardui and *huntera* are both natural immigrants, the former feeding mostly on malvaceous plants and introduced thistles, but also on *Gnaphalium*, on which the latter habitually feeds. In dry districts on the lowlands both these species become abundant on the appearance of a fresh growth of vegetation following copious rain, but disappear with the drying up of low plants. *V. cardui* sometimes entirely strips the common weeds on which it feeds, so that we have even seen the caterpillars perishing of starvation. It is sometimes much parasitized by the Tachinid, *Frontina*. A considerable percentage of the Hawaiian *cardui* are intermediate between the var. *kershawi*, which has been considered by some a distinct species, and typical *cardui*, while some are typical *kershawi*. Eggs laid by the same female may produce both forms and intermediates.

V. atalanta has only been found on the island of Hawaii, where it is sometimes abundant in the mountain forests. It was not noticed by Mr Blackburn during the period of his collecting, and is probably a recent arrival. It is quite doubtful whether it is a natural immigrant at all, and we suspect it may have been introduced by man. It is at least remarkable that in the past 18 years it should not have spread to the other islands. We have found it very numerously in Olaa, Hawaii, flying freely even in the heavy rains of that rainy district, and visiting the flowers of *Rubus*. Sometimes also it was attracted at night to the lights in the house. It is abundant too in the Kona district.

V. tammeamea is by far the most interesting of the few Hawaiian butterflies, being found throughout the forests of all the islands, and at times it is even seen in gardens in Honolulu. Such visits, however, are accidental, and usually occur during or after stormy weather in the winter months. The butterfly itself is remarkable for the great variation of the under side of the wings, whereas the coloration of the upper side varies but little. The sexes are easily distinguished by the difference in colour of some of the small spots in the black apical part of the front wings, these spots being pure white in the female. The flowers of *Broussaisia* are often very attractive to this butterfly, as are those of an introduced *Rubus*, but more often it is found feeding on the exuding sap of *Acacia koa*, *Myoporum*, and other common forest trees. Having a very powerful flight it is sometimes met with far from its usual haunts, as for instance on the tops of the highest mountains or near the sea-coast. The caterpillars are very variable, being sometimes green or purplish or particoloured. When young they fold back a small part of the leaf and thus conceal themselves, but when larger often feed exposed. Their food consists of various urticaceous plants, especially *Pipturus albidus*, but *Urena* and other genera are also attacked. On one occasion a female butterfly was observed near the coast at Honolulu ovipositing on young plants of the common malvaceous weed, on which *V. cardui* is so abundant. By following this female as it flew from plant to plant, a number of eggs were collected, as they were laid. The caterpillars however, when they hatched out, refused to eat the young growing plants on which they were placed, and, after crawling about these for a day or more, died of hunger. Others from the same lot of eggs, being given leaves of the native 'mamake' (*Pipturus*), survived. It would therefore appear that the butterfly, when driven from the mountains to the lowlands, where the usual Urticaceae are absent, will select as a food-plant for its caterpillars or rather for ovipositing, one which is freely fed on by allied species of its genus (e.g. *V. cardui*), although its own caterpillar is not able to subsist on this. Possibly the instinct of selecting this malvaceous plant is an ancestral one, still retained, though now fatal to the progeny.

The chrysalis of *V. tammeamea* is occasionally found suspended from the leaves of various trees or plants in the forest, but we have more often found parasitized examples

u 2

than sound ones. From the former one breeds the Pimpline Ichneumon, *Echthromorpha maculipennis*, and of late years, occasionally, the imported Chalcid, *Chalcis obscurata*. In spite of these enemies, and, sometimes, of Tachinid flies, the Kamehameha butterfly is a common insect, and at the same time the finest and most conspicuous in the Hawaiian fauna. As many as a dozen or two may at times be seen flying around some injured Koa tree, from which sap is exuding, or resting on its trunk or branches. On such occasions it is sometimes possible to place a net over some half-dozen individuals at once. Only a small proportion of examples caught in the field are in perfect condition, the wings, though strong, being apparently very brittle. Although the butterfly bears a general resemblance to other species of *Pyrameis*, the caterpillar is so very distinct, that it would be taken to belong to some other genus. The very numerous stout spines with which the head is set, the absence of any mediodorsal line of spines, and the enormous development of two apical abdominal ones, give it an extraordinary appearance.

Lycaenidae.—*L. boetica* is ubiquitous throughout the group, feeding on many leguminous plants in the open country, and we have found it at an elevation of some 7000 ft. in the mountains frequenting the flowers of *Sophora chrysophylla*. It is apparently free from the attacks of parasites, but both larvae and eggs are destroyed by the ant *Pheidole megacephala*. The date of its importation is not known, but it has been present for more than thirty years.

L. blackburni is not at present known outside the islands, though it will quite possibly be found elsewhere. Though chiefly found in the mountains, it is also frequently common on the lowlands, sometimes occurring commonly in gardens in Honolulu. In the latter, the caterpillar[1] feeds on various foreign trees that bear pods; in the mountains it infests the pods of *Acacia koa* and the leaves and capsules of *Dodonaea viscosa*. This species is not known to be attacked by any parasites, nor does it exhibit any striking variation.

During recent years other two Lycaenidae have been imported, as destroyers of the flowers and seeds of *Lantana camara*. They are natives of Mexico, where they are so greatly attacked by parasites, that fully 90 per cent. of the larvae were destroyed by these in their native country, and the butterflies rarely seen. In the islands they become excessively numerous, whenever the Lantana flowers freely enough to admit of their multiplication. They are apparently exempt from parasites, though the eggs are often much destroyed by *Pheidole*.

Phycitidae.—The few Hawaiian representatives of this family are small, obscure species, all but three or four being introductions imported with articles of food.

[1] Mr J. C. Kershaw informs me that this caterpillar is devoid of the usual glands found on the abdominal segments of Lycaenid caterpillars. If the butterfly is really endemic, this fact in connection with the absence of any native ants, except the entirely terrestrial *Ponera perkinsi*, is interesting, since the excretion of these glands is habitually eaten by ants.

Genophantis, however, is an endemic genus (liable to prove apodemic on further research in other countries) and the species of *Homoeosoma* are also endemic. All these insects are attracted freely by light and all the species are common in their proper haunts. *Genophantis* is attached to Euphorbiaceous, *Homoeosoma* to Composite plants. The larvae are sometimes found stored up in the cells of *Odynerus*, and they are parasitized by the Ophionines of the genus *Limnerium* and *Lathrostizus* and sometimes by *Chelonus blackburni*.

The most interesting species of this family is one whose caterpillar is excessively abundant in the flowering stem of *Argyroxiphium*, the silver sword plant, a composite found plentifully near the summit and in the crater of Haleakala. Probably this insect will form a new genus, the species being as yet undescribed. Of many hundreds of caterpillars brought down from the crater to Honolulu in 1896 only one or two produced moths.

GALLERIADAE.—The single representative, *Meliphora grisella*, is of course an importation with honey-bees, and of no special interest.

CRAMBIDAE.—There are half-a-dozen endemic species of *Talis*, small obscure grass-moths, some of which exhibit a good deal of variability in markings and colour. They are able to flourish in the driest localities near the coast, and also frequent open parts of the forest region in the high mountains. Most and probably all the species are under favourable circumstances very numerous in individuals. They are easily disturbed in the daytime and are attracted very readily to light at night. The larvae of one or more species have been found at the roots of tufts of grasses. Of the habits of the single *Prionopteryx* nothing is known and its claim to be endemic is quite uncertain.

The *Euchromius* is a foreign species, now fully established on several of the islands, frequenting the lowlands and lower mountain slopes, below the line of forest. We have seen it flying in numbers in the daytime amongst grass and *Sida rhombifolia* on Molokai at elevations below 1000 ft. during the cooler months of the year.

PYRAUSTIDAE. This is by far the most extensively represented family of the larger Lepidoptera. Eighteen genera are at present known, but of these four—*Nymphula*, *Evergestis*, *Nomophila* and *Hellula*—contain each a single foreign species only. On the other hand five genera—*Hyperectis*, *Promylaea*, *Mestolobes*, *Orthomecyna* and *Protaulacistis* are endemic. *Hymenia* is represented by one apodemic and widely distributed, and one endemic species. The remaining eight genera, though apodemic, contain only endemic species. *Hellula undalis*, the caterpillar of which is the well-known 'Cabbage web-worm' of America, has of course been introduced by man, and *Evergestis anastomosalis* is a still more recent introduction from the oriental region. It is injurious to the sweet potato, in the stems and tubers of which it burrows, and has already spread from

Oahu to other of the islands. The moth, first noticed in 1900 as a great rarity, is now common in Honolulu, coming to the lights at night. *Nomophila noctuella* is probably a natural and not infrequent immigrant, being abundant locally some years and not noticed at all during others. *Nymphula* is either immigrant or more probably introduced. *Hymenia recurvalis* is almost the most abundant moth in the islands, and not only occurs on the main islands of the group, but also on the small and far distant outlying ones. Its polyphagous larva is a common prey of various wasps of the genus *Odynerus*. Not only foreign weeds and economic plants, but the endemic *Nototrichium* is riddled by these caterpillars. Locally, remarkable aberrations are met with, but always rarely and exceptionally, and it is questionable whether the supposed second species[1] of the genus is an extraordinary aberration or really distinct.

The caterpillars of the genus *Omiodes* have been specially studied by Swezey, who of late years has applied himself to the investigation of the early stages of the native Lepidoptera with great perseverance and success. The larvae of all the species of this genus that are known, with the exception of *O. monogona*, feed on monocotyledonous plants. That species is attached to various leguminous plants and frequently quite spoils the appearance of the clumps of 'wiliwili' trees, that grow in gulches at low elevations in the mountains. Most of the species feed on grasses, sedges, liliaceous plants, palms or bananas. *Omiodes blackburni* is responsible for the defoliation of coconut palms throughout the islands. It attacks also various other palms and more rarely the banana. On the latter are found several closely allied species, which, unlike *O. blackburni*, are restricted to the mountains. It would be premature to state that these banana-feeding species *O. meyricki*, *O. maia*, and *O. musicola* have no other food-plant, but they have not so far been found on others. If it proves that these (and certain other insects) are really restricted to the banana it would strongly influence us in the belief that this plant is a truly native component of the flora and not merely an aboriginal introduction, a belief further strengthened by the fact that one of the most peculiar Hawaiian varieties of banana is said to sometimes produce seed. Another interesting group of species is formed by *O. antidoxa* and its several allies, but the food-plants are more varied in this group, Liliaceae, Flagellariaceae and Cyperaceae being affected. By far the commonest and most ubiquitous species of the genus are those feeding on grasses, e.g. *Omiodes localis*, *continuatalis*, *demaratalis* and that pest of sugar-cane *O. accepta*. These are very abundant, and are seen on the wing or are readily disturbed from the herbage, as one walks along in the daytime. Almost all the species of the genus are attracted by light, and some, unless captured this way, or bred from the caterpillars, are not likely to be met with except by the rarest chance.

Though living in the concealment of retreats, formed by rolling up the leaves of the plants on which they feed, or otherwise hidden, the caterpillars are attacked by many natural enemies. A *Pentarthron* destroys the eggs of some species and the

[1] This or another allied species has now been found on Maui by Mr J. F. Rock.

caterpillars are now greatly attacked by *Bracon omiodivorum* (an introduced species) and the Ophionine *Limnerium blackburni*, sometimes also by a species of *Enicospilus* in the latter group. The two common Tachinid flies, *Chaetogaedia monticola* and *Frontina archippivora*, also parasitize the caterpillars. The Pimpline Ichneumons, *Echthromorpha maculipennis* and *Pimpla hawaiiensis*, as well as the very abundant, imported *Chalcis obscurata*, are bred from the pupae. From one of the forest-frequenting species (*O. asaphombra*) Swezey has bred the Bethylid, *Sierola dichroma*, and it is likely that others of this genus will attack other *Omiodes* larvae. In addition to these parasites, various species of *Odynerus* carry off the caterpillars to store their cells. *Odynerus nigripennis* is a constant enemy of *Omiodes accepta* and other grass-eating species, as well as of the leguminiphagous *O. monogona*. The rarer wasp *Odynerus epipseustes* has been noticed hunting for the caterpillars of *Omiodes continuatalis*. The imported social wasps of the genus *Polistes* also use those of various species, as food for their young, while various other polyphagous predators feed on them when opportunity offers.

The species of *Phlyctaenia* are numerous, twenty-six having been already described, while others have since been discovered. In their larval habits they much resemble *Omiodes*, and some of them are amongst the most abundant of moths. They differ, however, in the fact that the caterpillars are entirely or almost entirely attached to dicotyledonous plants for their food supply, though I have some suspicion that the Omiodes-like *P. heterodoxa* will be found to live on *Sisyrinchium* or some other monocotyledon. In the forest region of the islands many trees or shrubs are attacked by the caterpillars of *Phlyctaenia*. Some species attack very different food-plants, e.g. the common *P. despecta*, which is extremely abundant on *Ipomoea* and various composite plants and occupies with equal success stations near the driest coasts or high up the mountains, where it can thrive in the wettest forests. Such species exhibit considerable variation as is natural, but it is not clear to what extent this is due to climate and to what extent to food-plant. Some of the species, e.g. *P. monticolans* and *eucrena*, vary greatly even when taken in the same station. Many of these moths are easily disturbed in the daytime, as one walks along, or are even on the wing naturally. *P. pyranthes* sometimes flies freely in the sunshine in open places in forests amongst *Vaccinium reticulatum*, on which the caterpillar feeds, being much more abundant than the moth. Like all the other members of the genus this day-flying species flies also by night and is attracted by light. *P. calliastra* was noted as flying freely at the approach of darkness, soon after sundown, then remaining quiescent till midnight or later, the period of activity of this, as of other species, being evidently very short. *P. micacea* may be noticed flying from tree to tree in wet forests, growing on rough lava flows, and settling on the mossy tree trunks. When at rest it raises the abdomen and has in consequence a peculiar appearance.

The natural enemies of *Phlyctaenia* are much the same as those of *Omiodes*, and in addition to these, *P. despecta* is attacked by the Braconid *Chelonus blackburni*. Probably the predaceous *Odyneri* and the parasitic *Limnerium* are their worst enemies. In one case a large number of caterpillars of *P. stellata* (a species extremely common on the urticaceous tree, *Pipturus albidus*) were collected, but only four moths were reared, 85 per cent. having been parasitized by the *Limnerium*, an exceptional death-rate.

The Hawaiian species of *Pyrausta* appear to resemble the *Phlyctaenia* in habits, and are mostly found in the mountain forests, within the rain belt. *P. litorea*, however, frequents dry sandy coasts, the caterpillar feeding on the leaves of that common immigrant plant, *Scaevola koenigii*. The commonest species is *P. constricta*, the caterpillar of which is common in the mountains, feeding on *Scaevola chamissoniana*. The moth is rarely seen on the wing, but is readily attracted to light, on the lower edge of any of the forests of Oahu, where the food-plant abounds. *P. litorea*, on the contrary, is very easily disturbed from amongst the leaves of its food-plant. The latter species is attacked by *Limnerium* and the introduced *Chalcis obscurata* and no doubt all the others will be found to be parasitized by these and other natural enemies that attack *Phlyctaenia*.

Mecyna aurora is a widely distributed species in the islands, but its endemicity is doubtful. Its habits are like those of *Pyrausta* and it feeds on various Compositae, native and introduced. Like the others it is attracted by light. *M. virescens* has all the appearance of an endemic insect. It is extremely variable in colour and chiefly abounds at high elevations, 4000 ft. or more in the mountains. It occurs in great numbers in open places in dry forests composed of *Acacia koa*, *Sophora chrysophylla*, *Myoporum*, etc., and flies readily by day, settling on the herbage, though it is also attracted to light. It favourite food-plant appears to be *Sophora*, which is sometimes badly eaten by the caterpillars. The latter are of bright colours, and were found to form a favourite food of the fine endemic Passerine bird, *Rhodacanthis palmeri*. These caterpillars also eat the leaves of *Acacia koa* and the moth sometimes occurs in places, where no *Sophora* grows, and at much lower elevations than 4000 ft.

The three species of Hawaiian *Loxostege* appear to be rare insects, probably owing to the fact that their larval habits are not known. They are attracted by light at night, but very rarely met with in the daytime. They are usually found in the belt of heaviest rainfall in the mountain forests.

Hyperectis is an endemic genus with only one species at present known, this having occurred on Maui and Hawaii. Probably this moth will be found to be quite variable in its markings, as of the few specimens obtained on Hawaii one is a remarkable aberration. It is attracted to light at night and was once taken on the wing in the daytime.

Margaronia is represented by two entirely dissimilar forms, the conspicuous green *M. exaula* greatly resembling foreign forms, and it must be looked upon with suspicion as regards its endemicity. The caterpillar is sometimes common on, or even injurious to, foreign Apocynaceous trees, grown in gardens in Honolulu. In the mountains it will no doubt be found to feed on trees of the same order, such as *Rauwolfia*, *Ochrosia* and *Vallesia*, and I have seen the caterpillars numerous on what I was told was a species of *Euphorbia*. This moth appears to frequent the lower borders of the forests and is sometimes disturbed from amongst ferns, where it flies wildly and rapidly and is generally difficult to capture. At night it is attracted by light. *Margaronia cyanomichla* is a widely distributed species throughout the islands, especially in the wetter forest regions. It exhibits a good deal of variation, probably in part according to the station it inhabits. It comes freely to light and is rarely met with otherwise.

Mestolobes and *Orthomecyna* are extensive endemic genera, with 30 species in the former, and 14 in the latter already known, and the two monotypic endemic genera *Protaulacistis* and *Promylaea* are offshoots of these. Some of the species of *Mestolobes* (e.g. *M. xanthoscia*, *minuscula*, etc.) are frequent visitors to flowers, flying freely in the sunshine and also at night, while others appear to be entirely nocturnal, and come very freely to light in company with the former. Some may be seen in numbers flying over or settling on ferns in shady places. Most of the species are entirely confined to mountain forests, but *M. minuscula* is ubiquitous, occurring near the sea-shore even on the leeward side of the islands, and thence upwards through the forest-belt. Not infrequently a small swarm will buzz around and even settle upon the person of the collector. In the forests it is usual to find several species in company, and individuals of two or three may be sometimes noticed on a single flower of the Ohia tree. The species that have been examined in numbers are generally very variable in coloration.

In general the habits of *Orthomecyna* are like those of *Mestolobes*, but in a number of species there is a tendency to fly low and settle on the ground or near it. These low-flying species are generally of obscure coloration, compared with the more arboreal forms. Some visit flowers of forest trees and some come freely to light. *O. epicausta*, *exigua*, and *mesochasma* are excessively numerous in certain localities at proper seasons. Some of these, like some of the *Mestolobes*, can be dislodged in extraordinary numbers from bushy trees, in which they are resting during the daytime. Nearly all the species are true forest insects, though they are sometimes found in the open country below or above the forest-belt. None seem to occur on the lowlands, at least not on the leeward side of the islands. Considered generally they do not seem to show any particular liking for the excessively wet parts of the forests, which are frequented by many species of *Mestolobes*. Like the latter, some are extremely variable in markings.

More than sixty species of *Scoparia* are already known, and no doubt many more remain to be discovered. They occur from the lowlands on the windward side to an elevation far above the forest-line on both sides of the highest mountains, but, except accidentally, are not found on the lowlands of the leeward sides. They are most numerously represented in the true forest-belt. As in other countries, they rest in the daytime on the trunks of trees and on rocks, but are easily disturbed, as one walks along. Some settle freely on the ground, in open parts of the forest, where there is a great growth of lichens amongst low-growing plants, such as *Vaccinium*, *Cyathodes*, and *Coprosma*. Many match in colour the lichen growths, that cover the branches and trunks of trees, on which they rest; but, as stated, they are so easily disturbed in the daytime that they are frequently snapped up by the fan-tailed flycatchers (*Chasiempis*) which, but for this habit, they might elude. In dense damp forests, where moss covers the trunks of trees, species with orange, yellow, or ferruginous colour (*S. ianthes*, *marmarias*, *nectarias*, *hawaiiensis*, etc.) are conspicuous; in drier and more open places, black and white species with sharply defined markings (*S. balanopis*, etc.) are often numerous, mixed with the dull and difficult species of the group of *S. meristis*, and the very distinct looking *S. venosa*.

The caterpillars of *Scoparia* feed on mosses and possibly also on lichens. Those of species of the *meristis* group are sometimes numerous beneath moss growing on perpendicular banks or road cuttings. They are much attacked by *Limnerium blackburni*, which may be seen flying along such banks in great numbers, and frequently settling and thrusting its ovipositor through the moss. Other species feed on the mosses growing upon the trunks of trees. Some occur above the forest-line on rocks, on which mosses and lichens grow together. According to Meyrick, "not one of the many species is even moderately variable," but possibly it would be more correct to say that the variability, which exists, though sometimes quite noticeable, is not of such a character as to obliterate the distinguishing specific characters. Apart from the *Limnerium*, above mentioned, nothing is known as to the natural enemies[1] of the Hawaiian *Scoparia*, but besides the flycatchers, *Oreomyza* and *Heterorhynchus* have been seen to catch the moths. The great abundance of individuals of many species is noteworthy, hundreds of specimens being seen around the lights at night in many places. Equally plentifully others are disturbed in open places in the forest region, as one walks along; while in some forests they fly off from every tree-trunk.

The two species of *Lineodes* are widely distributed throughout the islands, but usually not numerous. They are easily disturbed in the daytime from low plants, on which they rest Pterophorus-like with folded wings, and they are also attracted by light. Probably they are most common in the more open parts of the forest, where *Vaccinium* or other low-growing plants cover the ground, yet we have even found one of the species on the dry leeward coast of Oahu, and their endemicity is doubtful.

PYRALIDIDAE.—The two species of *Pyralis* are introductions by man, and of no particular interest. *P. manihotalis* is common in many houses in Honolulu, while *P. mauritialis* is still more common, the caterpillar feeding on the nests of the introduced social wasps (*Polistes*). The latter moth is véry readily attracted by light.

PTEROPHORIDAE.—*Trichoptilus oxydactylus* is throughout the group a very abundant littoral or sub-littoral species, extending its range to the forehills. The caterpillar is

[1] Probably they are parasitized by the Bethylid *Sierola*, which has a wide range of hosts in Lepidoptera.

found abundantly feeding on *Boerhaavia*. This moth is probably a natural immigrant, having a very wide range outside the islands, and it is found on the small outlying islands of the group, e.g. on Midway Is. It comes freely to light.

There are four known species of *Platyptilia*, one of which, *P. fuscicornis*, is probably an importation with plants. It is a very common insect, and the caterpillars, which, like the pupae, vary in colour, are found on the flowers of the common weed, *Ageratum conyzoides*. I have bred the same species with several others from flowers of *Lantana camara* sent from Mexico. *P. rhynchophora* is generally distributed throughout the group, wherever *Vaccinium reticulatum* flourishes, at elevations of from 2000 to 9000 ft. above sea-level. The food-plants of the other species are not known.

ORNEODIDAE.—Only two species of *Orneodes* are known, and these have only been taken on Kauai and in the western mountain range of Oahu, but as they are very rarely met with in the perfect state they will probably be found to be more widely distributed. The Oahuan species, *O. objurgatella*, was once bred in large numbers from the drupes, I believe, of *Plectronia*.

GELECHIIDAE.—Represented by 11 genera containing 45 species. *Phthorimaea operculella*, the common pest of the tobacco plant, is of course an introduction, as also is the cotton insect, *Gelechia gossypiella*, and the single species representing each of the genera *Stoeberhinus* and *Autosticha* are also importations, which, owing to their habits, might very probably have been brought to the islands by the natives before the coming of white races. *Merimnetria* represented by a single species, only once captured, is of uncertain status. *Hodegia* with one described species (but of which others are known to occur), *Ptycothrix* and *Catamempsis* also monotypic, and *Psychra* with two species, are developments of *Thyrcopa*. The latter with 26 (and others undescribed) and *Aristotelia* with nine absorb most of the species of the family. The six genera *Merimnetria*, *Hodegia*, *Ptycothrix*, *Catamempsis*, *Psychra*, and *Thyrcopa* are endemic.

The species of *Aristotelia* are found amongst *Gouldia*, and the swellings on the twigs made by one of the species are very common objects. After the escape of the insects these swellings are often the home of more than one species of *Proterhinus* and other insects. *Neolelaps* is bred from these galls, but is probably parasitic on the beetles. The moths themselves are not very often met with in general collecting. The caterpillars are parasitized by the Chalcids of the genus *Eupelmus*. *Stoeberhinus* and *Autosticha* are both common in Honolulu gardens and elsewhere, their larvae feeding on all sorts of dried or dead vegetable matter. They are attacked by the small Braconid, *Microdus hawaiicola*. Both come to light at night, the former in very great numbers, the latter less frequently, but it is often seen at rest on the sides of houses.

It rests with the foreparts much elevated, and thereby has a very distinctive appearance, quite unlike *Stoeberhinus*, some varieties of the female of which it much resembles in superficial appearance. *Gelechia gossypiella* is of recent introduction, and quite injurious to cotton-bolls. It first appeared in the grounds of the Department of Agriculture, and was no doubt imported with cotton-seed. It is parasitized by the foreign Braconids, *Chelonus blackburni* and *Microdus hawaiicola*. The tobacco pest, *Phthorimaea operculella* is also very numerous, and an earlier introduction, having been collected by Blackburn. It is parasitized by the common *Limnerium blackburni*.

Hodegia apatela, a flightless jumping insect with abbreviated wings, is only known in the female sex, the male probably being fully winged. It was found in the wind-swept open country near the summit of Haleakala, and one or two similar forms have been seen on the open lower slopes of Molokai, below the forest region, a locality also constantly swept by strong winds. *Catamempsis decipiens* is very common in the larval state, infesting the Ieie (*Freycinetia*) and sometimes injuring the shoots, but the moth is not very often seen at large. The numerous species of *Thyrcopa* are mostly feeders on dead wood, some occurring in the driest localities, living in the stems of both native and introduced plants, and one of them is common around Honolulu, feeding on the dried droppings of cattle. The moths are, many of them, very readily attracted to lights, and are very numerous in individuals. The caterpillars of some species, however, feed on living shoots, and some live in decaying logs so wet and rotten that the water can be squeezed from the wood. Some of the species are very variable, and in some there is a striking sexual dimorphism. The caterpillars in some localities (especially on the lowlands) are a favourite prey of the wasps of the genus *Odynerus* and *Pseudopterocheilus*, and in mountain districts they are eagerly sought for on the dead branches of trees by various Drepanid birds, e.g. *Hemignathus* and *Heterorhynchus*. We have also found them in the stomach of the little flycatchers of the genus *Chasiempis*, which may be seen investigating fallen decayed tree-trunks in search of this food.

OECOPHORIDAE.—*Ethmia colonella*, the solitary representative of the family, is known to have been introduced. Its food-plant is the 'Kou' (*Cordia subcordata*), a tree no doubt introduced by the natives themselves, who valued it highly. Since the introduction of the *Ethmia*, this tree has been robbed of all its beauty; many indeed have been entirely destroyed, while others are either continually defoliated or have the foliage so riddled by the attacks of the caterpillars as to be unworthy of preservation. The gaily-coloured caterpillars seem to be remarkably free from the attacks of any natural enemies, but sometimes the omnivorous ant *Pheidole megacephala* destroys numbers of them. The moth itself is comparatively rarely seen, though it may be found resting on tree-trunks and occasionally visits lights.

Hyponomeutidae (including Elachistidae and Plutellidae).—Several of the eight described species of *Batrachedra* are known to be attached to ferns, on which the larvae feed. Some of the species are very numerous in individuals and they may be swept or disturbed from ferns in any number during the daytime. Both the wiry *Gleichenia* and soft ferns are affected by the caterpillars. It is possible that all the Hawaiian species are feeders on ferns.

The habits of the three Hawaiian species of *Agonismus*, an endemic genus, and two of *Elachista* are at present unknown. Of *Stagmatophora* the three species, *S. incertulella, S. honorariella* and *S. quadrifasciata*, are no doubt introductions by man. The latter is a common insect in some Honolulu gardens, and generally throughout the islands, on the lowlands, being attached (as is *S. incertulella*) to *Pandanus odoratissimus*, and various cultivated species of this genus. The caterpillars feed internally in the dead leaves and before pupation form a large oval case, which they usually drag inside, between the upper and lower surface of the leaf, in which they have fed. The dead leaves of the trees are often riddled with the holes, from which the cases have been formed. These Pandanus-feeders would be very liable to have been carried around from group to group of the Pacific by the natives in their migrations. *S. sordidella* is doubtfully congeneric with the other species and its habits are not known. *Aphthonetus* with 29 species is endemic. The moths are common on tree-trunks or hiding amongst the foliage of trees and ferns and are readily attracted by light. The genus is connected with *Neelysia*, which contains 31 species, and probably has similar habits, by *Rhinomactrum* (with two species), both these genera being also endemic. Of the great endemic genus *Hyposmocoma* 177 species have been described, forming a varied and probably heterogeneous assemblage of forms, with, evidently, a considerable variety in habits. Many of the moths are extremely common, resting by day on rough tree-trunks, from which some readily take flight on the approach of the collector. Others are disturbed in quantities from amongst dead fern-fronds, or dry limbs of trees, or from dense bushy trees or shrubs, especially certain varieties of the Ohia tree (*Metrosiderus*). Many are readily attracted by lights. A group of yellow or orange-coloured species are very conspicuous objects on the intermediate islands of Maui and Molokai. Some of the species exhibit much variation in colour, and when series of individuals have been collected from a great number of stations it is probable that the discrimination of the species will become a very difficult matter. Some of the caterpillars feed in dead wood or bark of trees and are quite naked, while others form cases of silk mixed with frass or *débris*. These cases exhibit much variety of form and appearance. Some are acute and spiniform, while others are broadly oval; some are dilated at each extremity, or pointed at one end and broadly rounded at the other, others are dilated in the middle. Some, found on lichen-covered trees, greatly resemble the surface on which they rest. Of several species almost incredible numbers may be found attached to rocks or bare vertical surfaces of decomposing lava, where the larvae no doubt feed on the microscopic vegetable growths. They are parasitized by the Braconids *Protapanteles hawaiiensis* and *Microdus hawaiicola* and also by the Chalcid *Omphale metallica*, which is so common on leaf-mining Tineina. Species of the Miscogasterid genus *Neolelaps* are also bred from wood affected by *Hyposmocoma*, but it is not definitely known whether they attack these caterpillars or other wood-eating insects found with them. I believe they are attached to the Coleoptera. The moths are often caught by the little fan-tailed flycatchers (*Chasiempis*) and by the native dragonflies. Though the chief home of *Hyposmocoma* is in the true forest-belt, some occur both below and above this belt. Even in the dry lowlands a few kinds are found, their larvae feeding on the low forms of vegetable life, growing on rocks and tree-trunks. On the wet side of the islands a once numerous lowland fauna has been, no doubt, well-nigh exterminated by the ant *Pheidole*. The habits of the allied monotypic genera, *Dysphoria* and *Bubaloceras*, are unknown. The former comes freely to light at night. *Euperissus cristatus*, the sole exponent of its genus, is very common in the larval state in the dead stems of *Freycinetia*. *Hyperdasys* with four and *Semnoprepia* with three species are found hiding amongst masses of dead fern-fronds or are attracted by light. All these genera, like *Hyposmocoma*, are endemic. *Diplosara lignivora* is a very common insect in the larval state, the cases sometimes being found by scores or hundreds beneath the bark of dead and fallen trees. The moth is freely attracted by light. *Blastobasis inana* is a foreign species and has been bred from stored yams imported from the Orient, though it had previously become established in Honolulu. *Endrosis lactella* and *Oecia maculata* are imported domestic insects, the latter parasitized frequently by *Protapanteles*. *Mapsidius* with three species is an endemic genus, the habits being unknown. The moths appear to be very rarely met with, the very conspicuous *M. quadridentata* was found in the bed of a mountain torrent, having been washed out by the heavy rains. The very variable *Prays fulvocanellus* is a common insect, often disturbed from the branches of trees. It is a true forest insect and almost certainly endemic. *Plutella maculipennis* is a pest amongst cabbages and other Cruciferae, and is of course introduced, there being no endemic Cruciferous plants in Hawaii. *P. albovenosa*, if it has the same habits, will also prove to be an importation. The first-named species is much parasitized by *Limnerium polynesiale*, and it is possible that this will prove to be the same as the *Limnerium* recorded as attacking the cabbage pest in North America, of which I have seen no detailed description.

The Hyponomeutidae with their 276 species are such an important element of the fauna that the following summary is of interest. *Oecia*, *Blastobasis* and *Endrosis* with single species, which are domestic or semidomestic, are introductions by man. So too is *Plutella cruciferarum* and probably also its congener. *Stagmatophora* has three species that are almost certainly introductions, and it is quite likely that the fourth may also be foreign. Leaving out of consideration these five genera with their nine species, there remain 15 genera with 267 species that must be considered endemic. *Prays* with one very variable species, *Elachista* with two (and no doubt others to be discovered) and *Batrachedra* with eight allied forms, some, and perhaps all, attached to ferns, are apodemic genera. The remaining 12 genera are all endemic and seem to be mostly intimately related to one another. Thus *Agonismus* is said to be intermediate between *Batrachedra* and *Hyposmocoma*; *Rhinomactrum* between the extensive genera *Neelysia* and *Aphthonetus*, while other genera represented by one or a few species seem to be special developments of some of these larger genera.

Carposinidae.—Thirty-three species of the genus *Heterocrossa* have been described, and doubtless many others remain to be discovered. The species appear to be often variable and very difficult to separate, a difficulty which will be much increased by the discovery of new forms. The moths are often very numerous, being attracted by light or disturbed from amongst foliage, especially that of the Ohia tree. They are also commonly found at rest on tree-trunks, and once, when sheltering from a heavy rain storm, I remember noticing half-a-dozen examples all close together on a single stem of a tree-fern, none of these individuals much resembling one another, and perhaps each formed a distinct species. The genus is not endemic and a species that I found resting on tree-trunks near Sydney (N.S.W.) had a very Hawaiian-like appearance. The caterpillars attack many kinds of fruit of forest trees and shrubs, e.g. of *Clermontia* and other Lobeliaceae, of *Vaccinium*, *Eugenia*, *Pittosporum*, *Mahoe*, *Sideroxylon* and, doubtless, many others. Others live in buds, e.g. those of *Metrosiderus*. These caterpillars are sought after by the wasps of the genus *Odynerus*, and as many as three dozen have been found in a single cell. They are also obtained by the native birds, while the moths themselves are often caught and devoured by the 'Elepaio' (*Chasiempis*) and by some of the Drepanididae, especially by those belonging to the genus *Oreomyza*.

Tortricidae.—The single species of *Eccoptocera* is one of the commonest of Hawaiian moths and is extremely variable. It is especially attached to *Metrosiderus*, and its caterpillars are much sought after by the wasps of the genus *Odynerus*. There is no reason to doubt its endemicity. *Crocidosema plebeiana* is a natural immigrant, attached to the immigrant plant *Sida*, in the buds of which the caterpillar lives. It is an important food-supply of the larvae of many of the endemic wasps, that frequent the lowlands and lower mountain slopes, since it is excessively numerous and ubiquitous, wherever its food-plant flourishes. Near Honolulu, *Nesodynerus rudolphi*, *Odynerus montanus*, and other wasps are always to be seen searching the 'Ilima' buds in their season for these small caterpillars. *Gypsonoma leprarum* is less abundant and may be an introduction. If not, it is probably a natural immigrant and will be found elsewhere. *Adeloneura* with half-a-dozen species described and others existing, is an endemic genus. The caterpillars live in the pods of the Acacias, *Acacia koa* and *Sophora* *chrysophylla*, and are injurious. *A. falsifalcellum* feeds on the beans in the pods of leguminous plants and also bores in the stems, sometimes destroying the plant.

The endemicity of any of the species of *Cryptophlebia* is doubtful. *Cryptophlebia illepida*, of which long series have frequently been bred, is much more variable in the males than in the females. It is extremely common, the caterpillars feeding in the pods of the imported *Acacia farnesiana* but also on the very different (Sapindaceous) *Nephelium litchi*. It also attacks *Cassia* and other imported pod-bearing trees, in which it resembles the allied *C. carpophaga*, which is known to feed on *Cassia* and *Nephelium*. In the mountains *C. illepida* is injurious to the native acacias, and the other two doubtfully-distinct species, *C. tetrao* and *C. vulpes*, will no doubt also be found on the same. There are five species of *Enarmonia* described. The status of these species is uncertain, as the variability is excessive, being somewhat similar to that of *Adeloneura falsifalcellum*. Examples with very little resemblance to one another are bred from the same brood of caterpillars. These feed in the pods of *Sophora* and of *Acacia koa* in the mountains, and are numerous enough to be injurious in some localities. *Bactra straminea* is a very widely distributed species in the islands and extremely variable, examples differing greatly in size and pattern. Probably several species are really included under this name, for we have observed scores of specimens in some localities, without remarking any special variability. If there is only one species, then the variation is to a large extent local or racial. Melanochroic forms occur and these are sometimes of gigantic size. In some varieties there is constant and conspicuous sexual dimorphism.

Of the subfamily Tortricinae, *Pararrhaptica* is represented by a single species, which greatly resembles some of the species of *Archips*, and, though peculiar to the islands, is probably an offshoot from the other. The species of *Archips*, nine in number, are, excepting *A. postvittanus*, endemic, as also are the very similar species included in *Panaphelix* (monotypic and endemic), *Dipterina* with one species and *Tortrix* with five. So far as is known all these greatly resemble each other in habits, and the borings of the rather large caterpillars in young shoots of *Myrsine* or other trees are often conspicuous and numerous. The moths are not very commonly met with, but some species are attracted to light. In the daytime we have usually disturbed them from amongst dead leaves lying beneath the forest trees, or found some of the prettily coloured green-marked species at rest amongst moss on tree-trunks in wet forests. The abundance of larvae compared with the rarity of the moths is quite remarkable. I think that I have obtained a species of the small Ophionine of the genus *Atrometus* from one of these Tortrices. The imported *A. postvittanus* is an injurious insect and has been found, in company with *Amorbia emigratella*, doing much damage to young fruits on orange trees, but both these species are polyphagous. When inspecting importations, we have found *A. postvittanus* on plants introduced from Australia, on hot-house trees from California, and on others from Mexico. It first appeared on Kauai in 1896, having probably been brought from

Australia with orange trees, as was the Australian Mantid *Orthodera prasina*, the latter being still confined to Kauai. The other importation, *Amorbia emigratella*, was first noticed in 1902, when the larva was already common on orange trees in Honolulu. *A. postvittanus* is a favourite food of *Odynerus*, especially of *O. nigripennis*, and its pupae are parasitized by *Pimpla hawaiiensis*, an imported Mexican Ichneumonid, while its eggs are destroyed by *Pentarthron flavum* (*Trichogramma pretiosa* ?). The other pest is at present much less attacked by natural enemies.

There are 10 species of *Capua*, all forest insects and no doubt endemic. Some of these are readily attracted by light, but very rarely found in the daytime, though sufficiently common. Some are known to be extremely variable. One is abundant in the drier forests, but the caterpillars[1], like those of *Epagoge* (with four species), have not been bred.

It will be seen that the Tortricidae present a great difference from the Hyponomeutidae in that there are no extensive endemic genera, the monotypic *Pararrhaptica* and *Panaphelix* being closely allied to apodemic ones, while *Adeloneura* has only half-a-dozen species, mostly small obscure insects, of which congeners might at any time be found elsewhere.

TINEIDAE.—The two species of *Opostega* are endemic and the perfect insects are probably difficult to collect. *O. dives* was found only once, the two individuals were taken running on a leaf of *Pelea* in the sunshine and one was noticed ovipositing. It is possible that the curious circular mines, that are so conspicuous in various localities in the thick leaves, are formed by the larvae of *Opostega*[1]. From these mines one generally breeds only Eulophid parasites. *Opogona aurisquamosa* is an imported insect, easily carried in the larval state with coconuts, sugar-cane, bananas and other plants. It usually feeds on dead or dry vegetable matter and is polyphagous. One or two other species, that have reached the islands on imported plants, have been intercepted and destroyed. The imported larvae of a pretty species, infesting the drupes of coconuts in Samoa, have more than once been bred to maturity. The species of *Ereunetis* are all no doubt introduced, their habits being in some cases like those of *Opogona*, *E. minuscula* and *E. flavistriata* being easily carried about with sugar-cane. In fact, another species, that infests cane, has still more recently been imported and become very numerous, even in some mountain forests. The dry leaf-sheaths of the sugar-cane afford a favourite food for the caterpillars, which hide between the sheath and the stem. Of *E. zebrina* little is known. Blackburn took it in Honolulu and I found my specimen on a trunk of the Kukui tree, also on Oahu. *E. simulans* is very abundant, the caterpillar feeding on dead bark of trees and the moth sometimes is common round the lights or may be seen resting on tree-trunks. It is found from the coast to an

[1] Species have since been reared from sandalwood by Mr H. Swezey, and *Opostega* has been bred by him from *Pelea*.

elevation of about 1800 ft. in the mountains and occurs in gardens in Honolulu. The caterpillar is sometimes parasitized by the Braconid, *Microdus hawaiicola*, and I believe also by a now very abundant species of Chalcididae (*Hockeria*) of recent introduction and not included in the systematic portion of this work. *Philodoria* is an important endemic genus with seven species described. The mines are very conspicuous in the leaves of the urticaceous *Pipturus*, many examples of *P. micropetala* sometimes being bred from a single large leaf. *P. splendida* is attached to *Metrosiderus* (Myrtaceae). In wet boggy forests we have noticed mines in quite different plants, amongst these being *Myrsine*, but *Pipturus* certainly is the food-plant of more than one species. Of *Gracilaria epibathra* the habits are not known, but *G. marginestrigata* is a very common insect, the larval mines in the leaves of *Sida* being very conspicuous. Besides this malvaceous plant it also mines the solanaceous *Datura stramonium* and some others. Other species of this genus are known, but have not been described in this work. Both *Philodoria* and *Gracilaria* are frequently parasitized by *Omphale metallicus*, and other minute Eulophidae. The four species of *Bedellia* are of some interest. One has been referred to the European *somnulentella*, and one to the American *minor*. The latter is very common, the larvae mining the leaves of *Ipomoea* of various species. The former, however, as well as the two species described as new, seems to occur in localities quite beyond the range of any Convolvulaceae, and to have some different food-plant. *Setomorpha dryas* is an introduced insect, and *Acrolepia aureonigrella* may come under the same category. The three species of *Monopis* and *Tinea* are of course importations and without interest, while the unique insect, for which the genus *Paraphasis* was made, is of uncertain status.

Review of Neuroptera.

One hundred and sixteen species of Neuroptera (s.l.) have been enumerated in the systematic portion of this book, and these represent but six families of the Order. If one excludes the Psocidae, of which very many species have been imported with plants from other countries (these species, however, not having been enumerated in this work), the Neuroptera are singularly free from artificially imported species, more so, indeed, than any other Order. There are, however, several species, which, we can be sure, are natural immigrants, viz. the three dragon-flies of very powerful flight, *Pantala flavescens*, *Tramea lacerata*, and *Anax junius*, all species of wide range and inhabiting the American continent. A small white ant[1], destructive to houses and woodwork all over the islands on the lowlands, has been established for many years, having, no doubt, been brought in with lumber. A few are of doubtful status, the Embiid, *Oligotoma*, and the Hemerobiid, *Megalomus hospes*, being probably either natural immigrants or endemic, while the ubiquitous *Chrysopa microphya* is more likely an importation. In

[1] One if not two other species of Termites have more recently been introduced into Honolulu.

the Hemerobiidae, one genus, *Nesomicromus*, of the Hemerobiinae, contains 22 known species, *Anomalochrysa* of the Chrysopinae 29, *Agrion* of the Odonata 26, *Psocus* of the Psocidae 14, and *Elipsocus* 10. No less than 101 of the species of Neuroptera are consequently distributed in only five genera!

Many families or even greater groups are totally unrepresented. Thus there are no Trichoptera, Perlidae, or Ephemeridae of the aquatic groups, no Mantispidae, Panorpidae, Ascalaphidae, etc., of the terrestrial forms.

HEMEROBIIDAE.—The single species referred to *Megalomus* is a rather common forest insect throughout the islands, the habits of which are very imperfectly known. It exhibits some rather remarkable variations, and though allied forms will, no doubt, be found elsewhere, it may itself prove to be endemic. We have not seen species from other countries having the same peculiarities of neuration, which will no doubt exclude it from the genus *Megalomus* properly called. It flies at dusk and sometimes is attracted by lights in the nighttime, hiding by day amongst dead leaves attached to trees, and amongst dead fern-fronds. When beaten from these it feigns death like others of the group.

The species of *Nesomicromus* exhibit a great variety of appearance, some having the remarkable contour of the wings of *Drepanopteryx*, though of course not allied to this, while others hardly differ from some species of *Micromus*, described from other countries. The more remarkable forms appear to be related to and connected by intermediates with the more commonplace ones. They are a difficult study, since many are so rare as to have been very imperfectly examined, and the difficulty is increased by the variability of the neuration and other characters. With the exception of *N. vagus*, which occasionally ranges to the coast, all are forest insects, many of them, as has been stated, rarely or very rarely collected. On the other hand *N. vagus* is often met with in great numbers. Mostly they frequent trees or ferns infested with Psocidae, on which they prey, but some, and especially those which are found most numerously, attack Aphidae. Amongst the latter may be mentioned *N. vagus*, *minimus*, and *fulvescens*. One is tempted to think that the greater abundance of such species is due to this habit, the large number of Aphidae, which have become imported with various plants, affording a more abundant pabulum. Probably Aphidae were entirely absent from the endemic fauna. *N. vagus*, the most successful of all the species, now sometimes abounds outside the forest in fields of sugar-cane attacked by *Aphis sacchari*, on maize, etc., and in the mountains we have found it in enormous numbers on the rare tree *Gossypium drynarioides* infested by *Aphis gossypii*. On one occasion the capsules of the latter plant were found full of the cocoons of *N. vagus*, the larvae having crept within for the purpose of pupation. If, as is probable, the Aphidae were absent from the fauna until they were imported by man, it is most likely that the Psocidae and small Homoptera previously supplied the sole food of

Nesomicromus, and their present diet of Aphidae is a return to the normal food of the family in other countries.

The genus *Pseudopsectra* is clearly an endemic offshoot from *Nesomicromus*, the posterior wings having become reduced to lobes, and the insect itself flightless. *Nesothauma* is a still more remarkable form, the hind wings having entirely disappeared, while the front ones have become hard like the elytra of a beetle, and their fringes have also vanished. It is allied to *Pseudopsectra*, and has been found in company with it, on trees covered with dense growths of lichens and harbouring many Psocidae. It varies much in colour, so that examples taken in the same locality appear superficially distinct from one another. The insects comprising these two genera are amongst the most remarkable of known Hemerobiidae.

Of the subfamily Chrysopinae one species of *Chrysopa* (*C. oceanica*) was brought back by the Beechey expedition more than three-quarters of a century ago, and has not since been met with. Probably it frequented the lowlands, and has become exterminated. In this connection I may add that a species of this genus is known to me from the far outlying island of Midway, but I do not know whether this is the same as the other, opportunity for comparison of description or specimens not having occurred.

Another species, *Chrysopa microphya*, now ubiquitous on the lowlands, and at moderate elevations in the mountains, is, I feel sure, a comparatively recent introduction. Its larva attacks many small insects, such as various scale insects or Coccidae, Aphidae, young leaf-hoppers, etc., and being numerous, it is decidedly beneficial. The larva carries the empty skins of its prey on its back in the usual manner, and the eggs are of the usual stalked form. The pupae are parasitized by a well-known American *Hemiteles* of the Ichneumonidae, but the proportion so destroyed is small.

Apart from these species all the Chrysopine Hemerobiids belong to the endemic genus *Anomalochrysa*, itself no doubt capable of subdivision, and embracing a wide variety of forms, 29 species having been discriminated. The eggs are simple, not stalked, and several are frequently laid side by side. They are parasitized by a species of *Pentarthron*, of the family Trichogrammidae (Chalcidoidea) which, however, may have been introduced. The larvae, some of which have been found preying on caterpillars, are often gaily coloured, the colouration sometimes resembling that of the adults, being green or yellowish, with a crimson or bright yellow mediodorsal stripe. The larger ones are able to give a sharp bite, when they fall on the bare skin. The adults are mostly entirely nocturnal, I think, though some of them are very easily disturbed by day. In open places in the forest, where the growth is short and scanty, and also in some places above or below the forest, *A. montana*, a small fragile species, often flies up as one walks along, and may even be on the move without being disturbed. I have seen this or an allied species in incredible numbers, when on my way in the early morning hours from the coast at Kawaihae to the uplands of Waimea on Hawaii.

Very few species, however, are found outside the belt of dense forest. *A. rufescens* occurs on the lowlands, as well as in the mountains, and may even be seen in Honolulu. We have found the females in numbers fluttering slowly about the foliage of Kukui trees at dusk, and ovipositing on these. The male is one of those remarkable for the extraordinary structure of the costa of the front wings. It and several others became numerous in the upland cane-fields of Hawaii during the worst period of the attack of the sugar-cane leaf-hopper (*Perkinsiella*), their larvae preying on this pest. No doubt in the forests they likewise destroy the endemic leaf-hoppers, though as above stated we have seen them sucking caterpillars of the genus *Scotorythra*. Many of the species of *Anomalochrysa* are remarkable for their variability in colour, and in characters of neuration. This variability renders the distinction of the species more difficult, so that the number of these may be subject to some correction, though probably the error is not great. The females lack some striking characters shown by the males, and are the more difficult to determine. Neither any of the species of *Anomalochrysa* nor *Chrysopa microphya* possess the offensive odour characteristic of some of the Chrysopae of other countries. Certainly *Anomalochrysa* is one of the most interesting components of the Neuropterous fauna, and an exact study of the variations of some of the species would be very desirable. Unlike *Chrysopa microphya* the larvae of *Anomalochrysa* are quite bare, not covering themselves with *débris* nor with the skins of their prey as the other does.

MYRMELEONIDAE.—The two species of *Formicaleo* appear to be allied to one another, but to have rather different habits. *F. perjurus*, the smaller species, is, doubtless, much rarer than it formerly was, and has entirely disappeared from some of the localities, where it formerly occurred. I have never myself met with this insect, but I once found a solitary larva, which I suspect belonged to it, beneath a stone on the edge of the stream in the Iao valley, Maui. It might almost have been said to be actually in the water. Three-quarters of a century ago this insect appears to have occurred near Honolulu, probably in the Nuuanu valley. The larger ant-lion, *F. wilsoni*, is a common insect on the driest lava-fields of Hawaii, where there is a scanty vegetation or the surface is barren. It occurs near the coast as well as at elevations of from 4000—6000 ft. above the sea. It is readily disturbed, as one walks along in such localities, by day, usually settling down again after no very long flight. We have seen it taking more extensive and higher flights at nightfall. The habits of the larva are not known, but probably it lives beneath stones or in cavities of the porous lava, as no burrows have been noticed where the species is common. It cannot prey on ants, for these do not exist in the uplands, where the ant-lion abounds. Some of its haunts are so barren that one may well wonder what insects are numerous enough to support the many larvae that must occur.

Embiidae or **Embioptera.**

Oligotoma insularis, the sole representative of this small family, is a common insect on the lowlands, and in dry places in the mountains to an elevation of some 2000 ft. above the sea. Blackburn reported it as occurring in the thatch of native houses, but it also is abundant under stones, amongst *débris* of fallen leaves and twigs, in the cavities of dead twigs and branches, and beneath the webs that it spins on the exposed trunks of large trees, in fact in many situations. Frequently small colonies of larvae, nymphs and adults are found in company. The winged males fly at night, and are attracted by light, and their appearance somewhat suggests that of certain Perlidae, their movements somewhat those of *Raphidia*, or still more of small exotic Mantidae. In whatever situation they are found they spin galleries of silk, along which they can travel rapidly either backwards or forwards. If the species is really endemic, which is very doubtful, it is one of the very few native species, not specially protected, which has escaped destruction from foreign predaceous insects in the lowlands. Possibly the galleries in which it lives may have saved it from destruction. Though here placed in the Neuroptera, *Oligotoma* would be less out of place amongst the cursorial Orthoptera.

Termitidae or **Isoptera.**

Only two Termites of the genus *Calotermes* are recorded in this work, but during the course of publication, one, if not two, other species have been imported, and are probably established. The names assigned to the species by McLachlan and adopted by me were given on the examination of winged examples only, and their correctness is very doubtful. The smaller species is clearly introduced, inhabiting houses and woodwork throughout the islands, but is not a forest insect. It has done much damage in Honolulu and other settlements, attacking many of the more choice woods. On the other hand, the larger species is a true forest insect, being particularly fond of dead Koa trees or the dead parts of living trees. Communities, however, are also found in detached logs of this and other wood, when lying on the ground. This species is variable, and examples of the soldiers taken from communities on different islands showed marked differences in the form of the underside of the head. The communities are often very large, occupying all parts of the trunk and branches of a large dead tree. The soldiers have distinct eyes, and a number of kings and queens may be found in one colony. The latter do not exhibit any noticeable post-metamorphotic growth, such as is so remarkable in the queens of many other Termites.

Psocidae or Psocoptera.

The species of this family are numerous, and very imperfectly known. The endemic forms appear all to belong to two types, each with numerous species, representing the genera *Psocus* and *Elipsocus*. Many of the species are very variable and also closely allied, and as they are fragile and often indifferently preserved, they are difficult to study. They are common throughout the forests of all the islands, and endemic species still occur near the coast in a few places. Of recent years great numbers of foreign forms have been imported with living plants, so that these are now found in every garden, and some, and probably many, of these have extended their range into the forests, and invaded the habitats of the endemic species. No doubt the existence of the native Psocids in the islands is very ancient, as they are well known to form the prey of other endemic creatures, e.g. the representatives of the Hemipterous family *Emesiïdae*.

Odonata.

The two foreign dragon-flies, *Pantala flavescens* and *Anax junius*, are extremely common insects, both being particularly abundant on the lowlands, and they range throughout the islands. *Tramea lacerata*, though not a rare insect, has been much less successful. It too is essentially an insect of the lowlands, or at least of low elevations.

Anax strenuus, superficially similar to *A. junius*, but much larger, belongs rather to the mountains, and may be found five or six thousand feet above sea-level. At moderate elevations of 1500 to 2000 ft., both these species breed freely in the pools of the mountain streams, and we have taken the male of the one attached to the female of the other on several occasions. I captured three such pairs in the course of two days, when collecting in the mountains near Waialua on Oahu. Owing to the peculiar method of copulation in dragon-flies, it is not possible to say whether this truly took place or not. Apart from size, these two species of *Anax* are quite distinct by other characters. As might be supposed the endemic *A. strenuus* is a very powerful flier, and on big streams and in open country is difficult to catch. Where they breed in small streams flowing down narrow gulches, or in pools in small ravines, as they continually pass and repass in their flight up and down, they may be easily taken. On the larger Wailuku river near Hilo, where they were abundant, they were easily killed with small charges of dust shot, as they flew over the surface of the water.

Nesogonia blackburni, a somewhat remarkable endemic dragon-fly, occurs on all the islands in the mountains. It is often observed in localities where very little water is to be found. This is due to the fact that it breeds in the small temporary pools that remain for a time after heavy rainfall, as well as in small and easily overlooked water-holes, that are of a more permanent nature. We have sometimes seen it in large numbers together, but more usually few or scattered specimens are noticed. On one occasion in a sheltered corner of a deep gulch on Molokai scores of examples could be seen at once resting with expanded wings on the dried stems of some low plant, nearly every stem having an occupant. Each day for a considerable period they were observed congregated in this favoured spot, but only during the late hours of afternoon sunshine. This dragon-fly exhibits much variation in colour, size, and other respects, and both general variability and local are evident.

The twenty-six species assigned to *Agrion* form by far the most remarkable portion of the endemic dragon-fly fauna. The variability of many of the species, in characters that are considered important, is unusually great. In some species the post-ocular spots may be conspicuous, reduced, or entirely absent, according to the individual. Other varieties in colouration may be still more striking. *A. amaurodytum*, for instance, may be an entirely blackish insect, with much bluish white pruinosity on the head, thorax and the base of the abdomen, or it may be of a more metallic black with conspicuous thoracic pale markings, or in addition to much pale ornamentation the abdomen may be largely red. There is very great variability in size of the individuals in many species. There is much general variation in examples taken in the same locality; in some cases there is sufficient difference between the aggregate of individuals of a species from one island and those inhabiting another to form more or less distinct races or subspecies. Thus the two species, *A. amaurodytum* and *A. calliphya*, are of much smaller average size on Hawaii than on the intermediate islands of the group, and their neuration is consequently affected.

The neuration of many of these Agrions shows much variation in detail, and this not merely in small points, but the more important features are in a plastic state. McLachlan, when he received material from Blackburn for description, some thirty years ago, formed a new genus for the reception of two species sent to him, calling this genus *Megalagrion*. This genus was essentially based on the neuration of the post-costal area of the wings, a number of the cellules in this area being doubled, instead of forming a single row. When, however, a more extensive collection of Hawaiian species is examined, it is found that this duplication of cellules exists in all stages of development. Species that normally have a single post-costal row of cells sometimes have a number of these divided to form a double row. In some cases the post-costal area is simple on the wings of one side of the insect, partially double on the other. A similar phenomenon is also shown in the series of post-pterostigmatic cellules, where a similar complication of neuration takes place, some species always having more or less a double row, others having sometimes a single and sometimes a partially double row, or the wings on either side may be different.

It is clear that increase of size of the insect favours duplication of the cellules, though it does not always necessitate it. Thus the three large species, which would more properly form McLachlan's genus *Megalagrion* (if that be retained) always have the complicated post-costal area to a greater or less extent. Some division of the cellules generally occurs in the large species *A. kauaiense*, on one side or the other, or in one or other pair of wings (fig. 1a, 1b, post-costal area of right and left front-wing). A large example of *A. deceptor*, as will be seen from fig. 2, has the post-costal area between the 7th and 16th cellule considerably complicated by division, though typically this species has a simple row of post-costal cellules. A small race of *A. calliphya* (named var. *microdemas* by me) is found on Hawaii. A dozen examples, taken at random and examined, all have a simple row of post-pterostigmatic cellules (fig. 4a and 4b) in both front and hind wings, whereas a dozen examples from Molokai, Lanai, and Maui, nearly all have this area more or less complicated by division of cellules (fig. 3a, 3b). In some of the smallest species of the genus the post-pterostigmatic and post-costal areas rarely, if ever, show any tendency to duplication of their cellules.

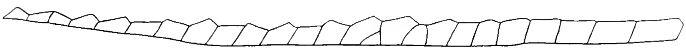

FIG. 1 a.

FIG. 1 b.

FIG. 2.

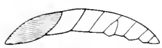

FIG. 3 a.

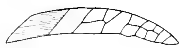

FIG. 3 b.

FIG. 4 a.

FIG. 4 b.

In many of the red-bodied species a tendency to melanochroism is a common form of variation. This tendency is particularly noticeable in individuals found in certain localities. In dealing with the three large, allied species, *A. blackburni*, *oceanicum*, and *heterogamias*, I remarked that the females of the latter were easily distinguished from those of the other two by the fact that the abdomen was not at all red, but entirely dark. At the time, I had seen a large number of examples of each of these species. Subsequently, however, I found that in other localities on Oahu (to which island it is confined) *A. oceanicum* also had a female entirely lacking the conspicuous red colour of part of the abdomen, and further in some localities this form much predominates.

Still later, on the island of Hawaii similar dark-bodied females of *A. blackburni* were observed, whereas those previously taken there (though in other localities) were red-bodied, as were all those found on the islands of Maui, Lanai, and Molokai.

Hitherto no dark-bodied form of the male of any of these species has occurred, all being largely red, nor has any red-bodied female of *A. heterogamias* (which is peculiar to Kauai) been found. Thus, it may be said that the females of *A. oceanicum* and *A. blackburni* are dimorphic, whereas the female of *A. heterogamias*, so far as is known, is not. Consequently *A. heterogamias* always exhibits striking sexual dimorphism. *A. oceanicum* and *A. blackburni* do so, when we consider the dark-bodied form of their females; but when we compare the red-bodied form of this sex with the other, the sexual dimorphism in the latter two species is much less marked. In other countries, Agrionids, the males of which are red-bodied, exhibit similar dimorphism in the females. Cases wherein black-bodied species are dimorphic, having a red-bodied[1] form in the male sex, are very rare, and I do not feel sure of having met with such, except in the case of *A. amaurodytum*, and but rarely in that species.

Extensive melanochroism of the (normally) largely red-bodied male of *Agrion deceptor* is common locally, and other species are affected less frequently, and in a lesser degree.

Only the very driest coastal regions of the islands and the highest elevations in the mountains above the region of streams and forest are devoid of any species of *Agrion*. *A. xanthomelas* is a common insect in Honolulu gardens and in lowland districts generally, not usually partial to the mountains, though in the Kona district of Hawaii it is common about stagnant pools up to an elevation of about 3000 ft. It is very numerous in individuals under conditions totally changed from the natural; perhaps it now finds more numerous breeding places, and a more abundant prey in the numerous insects that have been introduced by man in the region it frequents. *A. hawaiiense*, another small species, is more local than the preceding, but also seems to generally breed in stagnant water. Where it frequents streams, like that of the Iao valley on Maui, we have noticed that its chief haunts are quiet small pools, often cut off, or at a distance, from the main stream. It also breeds numerously in upland ponds of considerable size, where these occur. *A. deceptor*, *microphya*, and *nigrohamatum* also sometimes breed in stagnant pools of water, but more often in the streams themselves, or at least in pools left standing in the beds of streams, when these cease to flow. Most of the other species breed usually in running water, but on one occasion we found the nymphs of the large *A. heterogamias*[2] numerous amongst dead decaying leaves lying on the ground, and saturated with the wetness oozing from a perpendicular bank, at the foot of which they lay. There was no standing water, and the spot was at some distance from a river, and had no connection with this. From this the transition of habits is not very great to what may be considered the true terrestrial, or one might in some cases say, arboreal species. These (*A. koelense*,

[1] Teneral or immature examples, which instead of having a black or metallic-black abdomen, have this of dirty red or pitchy colour, are not to be confused with truly red-bodied examples.

[2] The nymphs of the allied *A. oceanicum* are sometimes found in the wet moss on rocks in stream-beds, and the young ones are preyed upon by the larvae of *Rhantus pacificus*.

A. asteliae, *A. oahuensis*, and others) deposit their eggs amongst the leaves of various plants which usually retain some moisture at the base, where they clasp the stem. Such plants are the climbing Ieie (*Freycinetia*) and the liliaceous *Astelia*. Here the nymphs, which are short and stout as compared with some of the slender stream-loving species, are found in numbers, those of several sizes often living in company. In wet weather, when a little water may collect at the bases of the leaves of the *Astelia*, we have noticed that the nymphs will often be found to have crawled half-way up the leaf, as if they actually disliked the wet! Both the *Astelia* and *Freycinetia* being favourite habitats of a number of native insects, it is probable that these nymphs fare fully as well as those frequenting the water. Thus the bases of these same leaves, and the decaying rubbish that accumulates there, are the haunts and breeding-places of various Nitidulidae and Carabidae, of small Diptera and their Hymenopterous parasites, of Lepidopterous larvae, of Hemiptera and other insects, as well as of others which casually seek shelter, and of the young of small land Molluscs. In consequence of their habits, these species of *Agrion* are frequently found in places quite remote from streams or standing water. The caudal appendages of the nymphs and the mask are much shorter than in some of the water-frequenting species, though there is much difference between some of the latter themselves in this respect.

The food of the adult Agrions consists to a large extent of small moths. We have also seen them take daddy-long-legs (Limnobiinae) and leaf-hoppers, and no doubt they prey on any small insect that flies by. The larger species, *A. oceanicum*, etc., not infrequently prey on the smaller, and themselves are devoured by the large endemic, *Anax strenuus*, and the immigrant, *A. junius*. On one occasion I caught an *Anax junius* devouring a male of *Agrion oceanicum*, which itself still retained hold of the small and delicate species, *A. leptodemas*, partially eaten. *Agrion blackburni* has been found devouring *A. nigrohamatum*, a species of considerable size, though much more slender than itself.

Considering the apparent scarcity of food, owing to the absence from the mountain streams and pools of more fragile water insects, such as Ephemeridae, Perlidae, Culicidae, etc., the abundance of the Agrions is quite remarkable.

To what extent the species of Neuroptera (s.l.), at present known only from a single island, are really confined to one, is at present in many cases uncertain, owing to the fact of their rarity. There is little doubt that the endemicity of the Kauaian species is in most cases real, for though the dragon-flies of Oahu have been much collected, yet of the 10 *Agrion* known from Kauai only two (which are generally distributed over all the islands) have been found on the neighbouring island. Otherwise the species of *Agrion* are frequently of wide distribution over the islands. Thus Oahu has four species (40 per cent.) endemic, and ranks next to Kauai, while Molokai, Maui, and Hawaii[1] have each but one species endemic, and Lanai has none.

[1] The species (*A. nesiotes*) supposed to be peculiar to Hawaii is now known from Maui.

The endemicity of the less easily collected Hemerobiidae cannot be properly estimated till much larger collections are made; but in its Chrysopinae there is no doubt that the island of Hawaii is disproportionately rich. It is now well-known that some species originally recorded from a single island are by no means confined to one, but range over two or several.

Review of Diptera.

The Diptera (excluding the Pupipara) are represented by 26 families, 10 of which, I believe, contain endemic species, and 13 only imported ones, the families Ephydridae and Agromyzidae being doubtfully represented by endemic forms. Excluding these latter, the native fauna belongs to the Mycetophilidae, Chironomidae, Limnobiidae, Dolichopodidae, Pipunculidae, Sarcophagidae, Anthomyidae, Trypetidae, Drosophilidae, Asteidae. In addition to these the Pupipara are represented by three species of *Olfersia* (Hippoboscidae), one of which is described from the islands, the other two are known elsewhere. Though found on the native Passerine birds, they also occur on wide-ranging sea-birds, and can only be considered as immigrant species. Excepting perhaps some of the metallic-coloured Sarcophagidae and a few of the largest Drosophilidae, the endemic flies are all of small size and of the most obscure superficial appearance. They have only been specially collected to a small extent and the number of those described can be but a fraction of those that exist. The extraordinary development of the Drosophilidae, in structure and in the number of species, is the most striking feature of the Dipterous fauna. The number of described endemic species of Diptera is only 135, while the introduced ones number 57. The former are contained in 27 genera, the latter in no less than 46.

Mycetophilidae.—This family is probably represented by endemic species of *Sciara* and *Platyura*, and as its members have been little collected other species and even genera are likely to be found. If preserved as dried specimens, these insects are subject to much distortion after death and often become hardly recognizable. It is probable that the truly endemic forms are numerous, the larvae being very plentiful in decaying vegetation, where they are preyed upon by the small Carabid beetles, and, if they have been exposed, are also seized upon by minute carnivorous flies belonging to the Dolichopodidae. A number of species have been imported with foreign plants and have become very abundant, so that it may not be very easy to discriminate the foreign from the native species in these obscure flies.

Chironomidae.—*Chironomus Hawaiiensis* is one of the commonest of insects, especially near the coast or on the lowlands. Its status as a native insect is very doubtful. Being freely attracted to light, it often swarms in the verandahs of houses, and forms a considerable part of the food of some of the lizards that haunt the same situation. The smaller Chironomids such as *Tanytarsus* and *Ceratopogon* are found in the mountain forests and the species may prove to be endemic. They have not been specially collected and the number of species that exist is quite uncertain. Some are also found on the coast, and about the salt marshes in the lowlands.

More interesting than any of these is an aquatic black insect, which often frequents strong mountain streams like that of the Iao valley in Maui. Mr F. W. Terry, who has studied its life-history, informs me that this species is of an undescribed genus, allied to *Telmatogeiton*. I observed it in great numbers in 1894 in the above-mentioned locality, when the river being in flood the flies were usually to be found sheltering behind large rocks projecting from the stream. They are also found on other of the islands, and are almost certainly endemic and an interesting addition to the scanty fauna of the freshwater streams. As a rule this insect preserves badly in dry specimens, and probably for this reason was not described in the systematic part of this work. In life, when I first observed it, it appeared to me one of the most remarkable of the island Diptera.

Psychodidae.—Only two species of *Psychoda* have been recorded, though one or two others have been observed. They are certainly all importations by man, and two of the species have been bred from cow-dung and from wet soil. They are of no interest in connection with the Hawaiian fauna.

Culicidae.—The two species of *Stegomyia*, *fasciata* and *scutellaris*, are well-known to all inhabitants as the 'day-mosquito,' owing to the fact that they are active at irregular periods between daybreak and dark, whereas the 'night-mosquito' or *Culex* is active at dusk and throughout the night. All have been imported by man and there is no native mosquito known, nor any true native name for a Culicid. *S. scutellaris* is of comparatively recent importation, as it did not come under my notice during the earlier days of my collecting, though now very numerous and conspicuous. Both it and *S. fasciata* are very troublesome not only on the lowlands but also in parts of the lower forests, where in the absence of pools or streams they can breed in great quantities in the small collections of water that form in hollows of the limbs of trees or where these join the trunk, as well as in the centres of decaying stumps. They do not generally seem to range upwards above an elevation of about 1500 ft. The *Culex* is also a species frequenting the coast and lower elevations, though exceptionally it has been found as high as 4000 ft. above the sea. *S. fasciata* is, as is well-known, a species of notoriety from its connection with yellow-fever, a disease at present unknown in the islands[1], and we suspect that *S. scutellaris* has a similar connection with the fever called 'dengue' (which is sometimes epidemic), though others would attribute this to the *Culex*. For

[1] A case of yellow fever has since been reported.

the latter, two specific names have been received from authorities at Washington and a third from the British Museum, so we are doubtful as to which it really belongs. Having no faunistic interest we have not specially inquired into this matter.

LIMNOBIIDAE.—The species of *Dicranomyia* are endemic, and to the five described, others and perhaps many more will, no doubt, be added. They are common insects, sometimes attracted by light and sometimes observed at rest in the daytime, or on the wing in the dark cavity of some hollow tree. In the latter case a number are usually seen flying together, rising and falling in their flight in the narrow space of a few feet. We have bred one or more species from decayed wood, overgrown with damp moss. These fragile flies are the favourite prey of the endemic predaceous wasps of the family Mimesidae, and some of the Crabronidae likewise gather them. Consequently one may find the females of these wasps investigating damp, dark places, where the *Dicranomyia* are likely to be found, but which ordinarily would have but little attraction for such sun-loving insects.

The single species of *Limnobia* is common in Honolulu (and elsewhere) and is I suspect introduced. It has been bred from damp moss. The *Trimicra* is also of doubtful endemicity. *Styringomyia didyma*[1] is extremely common near the coast around Oahu and perhaps on the other islands. It sometimes swarms at night around the electric lights, sitting quietly on the walls and ceilings, with the body pressed closely to the surface, and the front and middle legs extended straight forward in front of the head in a characteristic manner. We have found this or a very closely allied species, as well as a much larger species, in Australia, and should its habits prove it to be liable to be carried by ships, we should consider it an importation into the islands.

STRATIOMYIDAE.—There are three species, all doubtless introductions by man, though two have not been yet identified from elsewhere. Of the two smaller species one a *Sargus* was already found in Honolulu 30 years ago, the other, *Acanthina*, has been evident for only about 15 years.

The conspicuous *Neoexaireta spinigera* is also of recent introduction, not noticed in 1897, but already common round Honolulu in 1900. It enters the lower forests and the larvae abound beneath the bark of some of the native trees, when in a decaying condition. This fly is now frequently carried off by the endemic fossorial wasps (Crabronidae) for the provisioning of their nests.

SCENOPINIDAE.—Like the above family this has no special interest to the student of the fauna. It is represented by only one or two foreign species of domestic habits.

[1] This species was subsequently bred by Mr F. W. Terry and I should consider it to be a probable introduction by man.

Dolichopodidae.—The two species of *Gnamptopsilopus* are no doubt introductions, *G. patellifer* having been long established, and it is one of the commonest of flies. *G. pallidicornis* is of recent introduction; it was first noticed in 1896, was more common in 1902 and is now still more frequently seen. Both are frequently bred from soil in which young plants are being raised. On the other hand the species of *Campsicnemis* and *Chrysotus* are endemic, and no doubt many new ones remain to be collected, as they are found throughout the forests, often in abundance. Unfortunately most of the small and obscure Dolichopodidae have very soft integuments so that in a few days or even hours after capture they become shrunken and distorted and almost useless for descriptive purposes. They require special collecting and preserving, and it would be safe to say that of this family at least 100 species might be procured in the islands. Several species that frequent wet moss have the wings reduced to filaments and are of course quite incapable of flight, but these interesting forms appear to shrivel and distort after death and should be preserved in alcohol. Many of the smallest species live on the ground beneath the shade of the trees, not only in wet but also in dry forests, and if the dead leaves be swept aside and the damp earth exposed, they are readily attracted thereto, and prey on the minute larvae of mycetophilids or other delicate creatures, that are exposed amongst the disturbed *humus*. The little flightless *Emperoptera* also has these habits, living in company with the small and equally active Hemipteron, *Nesidiorchestes*, and other small insects, all flightless. The remark in the systematic portion of this work that it was taken '*on Freycinetia*' is incorrect and no doubt due to a wrong label having been attached to some of the specimens. It is altogether terrestrial. Several commonplace Dolichopodidae found in and around Honolulu are probably foreign (*Medeterus* sp.? &c.).

Pipunculidae.—About a dozen species of the genus *Pipunculus* are already known and probably numerous additional ones remain to be discovered. These species are difficult to discriminate being mostly closely allied to one another, and some of them apparently vary very greatly in size, perhaps in accordance with that of their host. Several, that have been bred, are all parasitic on Delplacid leaf-hoppers, chiefly those of the genus *Nesosydne*. The one species *P. rotundipennis* belongs to a different section of the genus from that, in which all the others are placed, and its host is not known.

Owing to the habits of the leaf-hoppers affected, most of the Hawaiian *Pipunculus* are to be found flying round ferns or forest trees and shrubs, since most of their hosts are to be found on these. They are never to be swept from grass, as is so often the case in other countries. At least two species attack the common hopper of the *Ipomoea* (*Nesosydne ipomoeicola*) and are found flying round Convolvulaceous plants, on which the host is so often found. Though all the species of *Pipunculus* are certainly endemic, yet two of them have attacked the introduced leaf-hopper of the sugar cane (*Perkinsiella saccharicida*) which is widely separated generically from the endemic hoppers. Most of the species of these flies are confined to the forests, but some stray below its limits and some above. Some are found in plenty, and individuals are to be seen constantly passing by on the wing, flying from plant to plant, the males in search of the females, the latter more carefully scrutinizing frond, leaf, or branch, in search of their hosts. Occasionally a pair are seen hovering in the air in copula, the larger male sustaining the female. As in other countries, the size of the fly, when bred, often appears very large as compared with the body of its host. So small a leaf-hopper as *Nesosydne raillardiae* will produce a comparatively large *Pipunculus*. The puparia, so far as is known, are always formed on or beneath the soil. They are never found exposed and attached to the surface of leaves as is the case elsewhere with certain (but probably few) species.

Syrphidae.—This important family is quite unrepresented by endemic forms and the few introduced species, excepting perhaps *Xanthogramma grandicorne*, a common Australian insect, are of quite recent importation. *Volucella obesa*, *Eristalis punctulatus*, *Syritta oceanica* and *Eumerus marginatus* have all become established during the years of my residence in the islands and all are now very common insects. The *Volucella* was first seen in 1894, while the others appeared between 1897 and 1900. *Eristalis tenax* was already common in 1892. It thrives best at high elevations in the mountains. The *Xanthogramma* is a very beneficial insect, but is unfortunately much parasitized by the ubiquitous Ichneumonid, *Bassus laetatorius*, and sometimes by a species of *Pachyneuron*, unless this latter proves to be parasitic on the *Bassus*. The *Syritta* breeds in decaying vegetable matter, and has been reared from pots containing plants, the soil of which had been mixed with horse or cow droppings.

Oestridae.—Represented only by three species, imported with domestic animals. These are *Oestrus ovis*, *Hypoderma bovis* and *H. nasalis*.

Tachinidae.—Represented by only three or four species, probably all foreign and most likely importations by man. A small unidentified littoral species might possibly prove to be endemic. *Frontina archippivora* is an extremely common fly, parasitizing *Anosia* and *Pyrameis cardui*, as well as the caterpillars of many moths of various families. It is of great economic value and is said to have been imported from America by Koebele. It is known to be of recent introduction. *Chaetogaedia monticola* is another very beneficial species, which attacks many of the most injurious caterpillars. Its habits have been studied by Swezey, and are of some interest, owing to the fact that it is one of those which deposit their eggs on the leaves of plants, instead of on a living caterpillar. It is of course largely a matter of chance whether the egg is swallowed by the latter, and hence the female fly is very prolific and the eggs minute. This *Chaetogaedia* may be a natural immigrant; at any rate it was universal throughout the mountain forests about 20 years ago. It would be interesting to compare a number of Hawaiian examples with N. American specimens, to make quite sure of their identity. It is a very favourite prey of the larger Hawaiian Crabronidae. Occasionally, like other parasites of caterpillars, it is itself parasitized by the imported *Chalcis obscurata*, though the latter is also normally a lepidopterous parasite. Like the Tachinids it may vary greatly in size according to the nature of its host.

SARCOPHAGIDAE.—The species of *Sarcophaga* are rather numerous and are all unquestionably importations from other countries, and their number has doubtless increased during recent years. Mr F. W. Terry, who has given much time to the study of the species for economic reasons, finds that the male genitalia afford excellent specific characters, but as these have been rarely described by systematists, the identification of the island species is almost impossible. *S. pallinervis*, one of the species described by Thomson from Honolulu, is identical with a North American one, while another is Chinese. *S. barbata* and *S. dux* are also common, but there are now other species present, so closely allied to the former that it is uncertain which of them is really Thomson's *barbata*.

These introduced *Sarcophaga* are now more or less attacked by Hymenopterous parasites, either casually or purposely imported, such as *Eucoila*, *Spalangia*, and several species of Pteromalidae, as well as Alysiidae.

S. pallinervis is the most ubiquitous of the island species, since the larvae live in the droppings of cattle, and it thrives at all elevations. It is greatly attacked by parasites, and is a favourite prey of the Crabronid wasps.

Apart from these foreign species of *Sarcophaga*, the family is represented by two endemic genera, of very great interest, and the most striking in appearance of any of the Hawaiian Diptera. These two genera are closely allied to one another and doubtless of the same origin, and it may even prove difficult, when all the species have been collected and studied, to maintain the generic distinctions between them. The blacker coloured species of the genus *Dyscritomyia* have in life a very Tachinid-like appearance and their behaviour in the field is also much like that of some of those parasites. The bright metallic green species of this genus and of *Prosthetochaeta* are in some cases more Lucilia-like.

As the development of these genera with their rather numerous and often highly remarkable species showed them, or rather their ancestors, to have been very ancient colonists of the islands, it became a natural question as to what their habits could be. Their Tachinid-like behaviour suggested that they might be parasites of Lepidopterous larvae, but the fact that they were not ever bred from these, though the latter were specially collected in a favourite locality for the flies, made this very uncertain. Excrement or carcases of mammals was out of the question from the absence of indigenous mammalia. So too with the birds, for the flies sometimes occur in dry, open, treeless localities, where are no birds. Many years of collecting had never revealed a large-sized fly maggot in decaying vegetation, not even in the most evil-smelling substances. Besides material of this sort is not found in the dry open country. These flies, so far as is known, are larviparous, the maggot, when born, being already of considerable size, so that there is some approach to the condition of the pupiparous flies. Some years ago Mr Terry reared one of these maggots to maturity on a mixed animal diet, including land molluscs. Later he obtained a new generation of flies from captured specimens kept in large glass jars and supplied with living and dead molluscs. Finally Mr D. B. Kuhns brought back Achatinellas (supposed to have been living when taken, but more probably recently dead) containing maggots, from which the flies were bred. Many shell collectors have noticed the occurrence of maggots in Achatinelline shells, found still fresh but not living, and we have ourselves sometimes picked up a number so affected in a single day. When one considers the great numbers of mollusca that exist in limited areas in the islands, it is certain that, even in a small area, many individuals must be dying each day of the year, quite sufficient to supply food enough to support the number of existing flies, especially as these when adult are very long-lived. Considering the well-known and very strong odour of dead land molluscs, these would not fail to readily attract creatures so keen-scented as Sarcophagous flies, probably long before the odour became appreciable to human senses. No doubt many kinds of molluscs serve as food for the maggots, for the flies are common enough in localities where only the thin-shelled *Succinea* is to be found. Species of this genus are to be found in very dry localities, and would account for the presence of the flies in such places.

The flies of both *Dyscritomyia* and *Prosthetochaeta* are difficult to determine specifically owing to the variability of individuals, the variation affecting important structures, e.g. the presence or absence of macrochaetae, which have been considered as of generic importance. Some of the species have very remarkable secondary sexual characters, and the male genitalia will evidently prove of great importance in the determination of the species. These flies are rarely found on the coast in dry districts or on the open forehills, but are common in open places in the forest, and occur also in dense forests, and are frequent above the limit of compact forest. Whether all are feeders on mollusca is of course at present uncertain. It is quite certain that they originally formed the exclusive prey of some of the endemic Crabronidae, and even now some of the latter have never been found to carry off any other kinds of fly. Some species of *Nesocrabro* may be often seen on the wing hunting beneath masses of fern or *Freycinetia* in damp shady places for these flies, which presumably are seeking there for fallen molluscs. All the larger species of Hawaiian Crabronids have at times been found carrying them off, and their burrows are frequently packed full of them to the exclusion of all other species. Certainly *Dyscritomyia* and *Prosthetochaeta* are amongst the most interesting constituents of the Hawaiian insect fauna.

MUSCIDAE.—This family is not represented by endemic species, but owing to the ease with which species are transported with stores of meat or in other ways on steamers, there is now a considerable number of foreign representatives. *Musca flavinervis* was described by Thomson from Ross Island, with a variety from Honolulu, and is not known to us. There is known, however, in addition to *Musca domestica*, a very distinct Chinese species, probably of recent introduction.

There are several species of *Calliphora*, the date of their introduction being uncertain, but the conspicuous *Pycnosoma dux* became common in Honolulu in 1900, and was no doubt introduced a year or two previously. *Lucilia sericata* appeared about the same time as the preceding, and spread very rapidly, and as the maggots seriously infest living sheep, it sometimes does considerable damage. *Rhinia testacea* also appeared first in 1900, and at once became very common. *Haematobia serrata* was imported in 1896, and is probably a worse scourge to horses and cattle in these islands than elsewhere in the world. It breeds everywhere in the droppings of cattle, and brood follows brood throughout the year. *Musca domestica* is also bred freely from cowdung found in open pastures. *Stomoxys calcitrans* is a common pest, of earlier introduction, since it was noticed in numbers on Hawaii in 1892. The flies of the genera *Calliphora* and *Lucilia* are often carried off by the predatory Crabronidae; so too, occasionally, is the common house-fly. They are also subject to the attack of some of the same parasites as the Sarcophagidae.

ANTHOMYIIDAE.—The genera *Hydrotaea*, *Ophyra*, and *Homalomyia* contain only imported species, as do some others yet undetermined, but the several species of *Lispe* are clearly endemic, and no doubt others will be added to these. They mostly frequent the forest, and do not seem generally to be common. I have taken the fossorial wasps, *Hylocrabro tumidoventris* and *Xenocrabro molokaiensis*, carrying off one of the species. *Coenosia* is an important genus with more than twenty species known to me in the islands, but further collecting should increase this total to one hundred. No doubt many of the species are rare. Nearly all are true forest insects, and they are best represented in wet woods. Many of the species are known to be carnivorous, preying on other weaker insects. The larger ones may sometimes be seen in some numbers on the trunks of trees, having a bold appearance, as they stand ready to dart off after some other insect. Sometimes the larger seize and devour smaller species of the genus. Like so many other flies, they are themselves preyed upon by the Crabronid wasps, the cells of which are sometimes found packed with nothing but *Coenosia*. Both the black- and yellow-bodied species are taken by the wasps. Their earlier stages are not known, but it is likely that some of the larvae that are found in the *débris* at the bases of the leaves of *Astelia* or *Freycinetia* may produce these flies.

Sciomyzidae.—A single species of *Sciomyza* alone represents this family, and so far it has only occurred on Oahu. Very probably it will prove to have been introduced, though at present only known from the islands.

Ortalidae.—*Euxesta annonae* is a very abundant introduced species, and is often bred from sugar-cane that has been attacked by boring beetles, or which is in a state of decay. It may have been imported with some of the varieties of sugar-cane brought from America, though it might equally well have been introduced in other vegetable matter. *Acrosticta pallipes* was probably of more recent introduction, as it has become very much more numerous during the last 12 years than formerly. Like *Euxesta* it also has been bred from unhealthy stems of sugar-cane, etc. A species of *Chrysomyza* appeared first in 1900, and of late years has become very common.

Thus all the representatives of this family are without doubt foreign, though the *Acrosticta* was described from Hawaiian examples, and the *Chrysomyza* is as yet not identified with any described species.

Trypetidae.—Excluding *Dacus cucurbitae*, a very common oriental species, which had become numerous in Honolulu in 1900, having been introduced, no doubt, some years previously, the Trypetidae are represented by a number of endemic species of *Tephritis*, and an endemic genus *Phaeogramma*. *Dacus cucurbitae* was originally described as Hawaiian, and no remark was made as to its being an introduced insect, though this fact was known to all in the islands, if not to the describer. It is, like other fruit-flies, a very troublesome insect, attached chiefly to Cucurbitaceous plants, but also attacking beans, tomatoes, and other plants.

Though only three species of *Tephritis* are enumerated in this work, they will, no doubt, prove rather numerous, when the endemic Composite plants are thoroughly examined. *T. crassipes*, though very similar to some of the other species, may prove to have been really an early introduction by man. It is bred in great numbers from the foreign weed *Bidens pilosa*, as well as from *Cosmos* and other garden plants. *T. cratericola* attacks the Silver-sword (*Argyroxiphium*), in some cases every achene being destroyed by it. It is equally numerous on *Raillardia menziesii*. *R. laxiflora* yields another species of the fly, as does *Dubautia*. *T. cratericola* is noteworthy for the fact that there is a difference in the sexes in the dark pattern on the apical portion of the wing. *T. crassipes*, above mentioned, is attacked by two Hymenopterous parasites, no doubt introduced, one a species of *Eurytoma* (Chalcidoidea), the other a *Bracon* (Ichneumonoidea). At present these have not been bred from any forest-frequenting species of *Tephritis*, though both are very common around Honolulu. Nor has *T. cratericola*, which lives above the forest limit, been found parasitized. The *Bracon*, however, is now found on other of the islands, and these parasites, if they attack the true mountain forms of *Tephritis*, may diminish their numbers. New species of *Phaeogramma* also probably await discovery, their secretive habits causing them to be easily overlooked.

SAPROMYZIDAE.—Of this family, only a single species of *Sapromyza* has been found, and that only in the immediate neighbourhood of Honolulu, rendering it highly probable that the species is introduced.

PIOPHILIDAE.—Represented only by the introduced *Piophila casei*, the produce of the cheese maggot.

EPHYDRIDAE.—Of the three genera enumerated, one, *Brachydeutera*, is represented by a single N. American species. The other two, *Notiphila* and *Scatella*, have each a species not yet known from outside the islands, but their claim to endemicity is uncertain. We suspect, however, that this family does contain endemic species.

DROSOPHILIDAE.—This family is a most important constituent of the Dipterous fauna, with nearly fifty species enumerated. They are very unevenly divided between three genera, *Hypenomyia* with one, *Idiomyia* with five, and *Drosophila* with the remaining species. The two former are endemic, and *Drosophila* is represented by an assemblage of species, exhibiting great diversity in structure and appearance, and will, doubtless, hereafter be found capable of division into other genera. At present these insects, many of which are obscure and minute forms, have been very imperfectly collected. To make an approximately complete collection and thorough study of the Hawaiian species would require the devotion of many years of special work. Not less than 250 species must exist in the islands, and double that number may very probably occur. Many of the species preserve very indifferently as dried specimens, and it is necessary that material should be preserved in alcohol as well as pinned. Those found in cool, wet forests often shrivel and distort, either soon after death, or when brought down into the hot and comparatively dry climate of the lowlands. Some of the species are quite conspicuous, and are readily attracted by the sap oozing from a broken limb of a tree, or from exudations caused by decay or disease. Very many breed in stems of trees or plants, which, when decaying, yield abundant moisture—such as those of the arborescent lobelias, of bananas, tree-ferns, etc. The larvae abound also beneath the bark of some forest-trees, which, when this is stripped off, reveal a semiliquid or pulp-like material covering the wood. Some of the larger and very many of the smallest and most obscure species live amongst the soft ferns, which grow in damp places beneath the shade of the forest-trees. The larvae of these flies are very subject to the attacks of Hymenopterous parasites, *Proctotrypes hawaiiensis*, and species of *Phaenopria* (Proctotrupoidea), several of the Eucoilinae (Cynipoidea) and *Spalangia lanaiensis* (Chalcidoidea) having been bred from them. The common Crabronid wasp, *Hylocrabro tumidoventris*, often fills its cells entirely with species of *Drosophila*, but the one which it most usually carries off is, I suspect, an introduced one.

Review of Hemiptera.

The Hawaiian Hemiptera present an interesting feature in the great difference between the constitution and development of the Heteropterous and Homopterous fauna.

Excluding the scale-insects (Coccidoidea) and the plant-lice (Aphidoidea), of which it is doubtful whether there is a single native representative, the total number of Hemipterous genera is 68, the species numbering 259[1]. Of these, 47 genera are Heteropterous, 21 Homopterous, while 126 species belong to the former, 133 to the latter division.

In the Heteroptera the following genera are represented only by species introduced through human agency: *Triatoma*, *Zelus*, *Alloeocranum*, *Clinocoris* (= *Cimex* and *Acanthia* Auct.), *Orthoca* (with two species, *O. nigriceps* and *O. vincta*), *Clerada*, *Rhopalus*, and *Geotomus*. *Triphleps* of the Anthocoridae and *Halticus* of the Capsidae are also certainly introductions, and one or two other Anthocorids and Capsids are also open to suspicion. The Pyrrhocorid, *Dysdercus peruvianus*, should be altogether expunged from the list, as, no doubt, having been brought forward on a wrongly labelled specimen. There was nothing like it in the Blackburnian collection, and I can only suggest *Ithamar hawaiiensis*, as the species, therein contained, which may have been supposed to be *Dysdercus*. Apart from these introduced species, the water-frequenting bugs *Arctocorisa blackburni*, *Buenoa pallipes*, *Merragata hebroides*, *Microvelia vagans*, and the pelagic *Halobates sericeus*, may be looked on as natural immigrants—the *Buenoa*, possibly an introduction by man—the three last-named being already known from other countries.

Excluding all the 15 genera and 16 species named, there remain to represent the Heteroptera 32 genera and 110 species. Twenty-one of these genera and all the species but one (the widely-ranging *Reduviolus capsiformis*) are at present supposed to be peculiar to the islands.

The indigenous fauna is made up of representatives of the following nine families only: ANTHOCORIDAE, MIRIDAE (CAPSIDAE), ACANTHIIDAE, MYODOCHIDAE (GEOCORIDAE), LYGAEIDAE, NABIDAE, REDUVIIDAE, THYREOCORIDAE and CIMICIDAE (PENTATOMIDAE). It must be remembered that of these the *Cimicidae*, *Thyreocoridae* and *Lygaeidae* are each represented by only one genus that can claim to belong naturally to the fauna, and that the total number of species is but four, so that these important families are almost unrepresented. The REDUVIIDAE have only a few species (in three genera) belonging to the *Ploiariinae*. The NABIDAE have a single genus with numerous species. On the other hand the CAPSIDAE (and in a less degree the ANTHOCORIDAE) are comparatively rich in genera, the former having no less than 14, but in these the total number of described species is only 24.

[1] September, 1909.

The Nabid genus *Reduviolus* and the Geocorid genus *Nysius* contain no less than 50 of the 110 endemic Heteroptera, and both of these genera are cosmopolitan or nearly so. The average number of species to a genus in the endemic Heteroptera is only 3·4, the many genera of Capsidae and Anthocoridae with few species, being effective in the reduction.

If we analyze the Homopterous constituents of the Fauna and exclude the following species, introduced by man, viz. *Peregrinus maidis* and *Perkinsiella saccharicida* (Delphacidae), *Siphanta acuta* (Poecillopteridae), *Centrotypus* sp.? (Membracidae) and *Phrynomorphus hospes* (Tettigoniidae), there remain 16 genera with 128 species.

The Delphacidae contain seven endemic genera, which are evidently allied to one another, with 46 species in all, and one genus (not endemic) *Kelisia*, of independent origin, with only three described Hawaiian species. The Tettigoniidae have four genera represented, one of these, *Nesophrosyne*, and its offshoot, *Nesophryne*, containing 51 described species, while *Nesosteles* contains four species, one of which is certainly, and one probably, foreign. The Fulgoridae have two genera represented, one *Iolania* with a single variable species, the other *Oliarus* (cosmopolitan or nearly so) with 24. The Psyllidae have two genera with four described species, all endemic. Subtracting the two probably introduced *Nesosteles*, we have 126 Homoptera distributed in 16 genera and four families, an average of nearly eight species to the genus. Twelve of the 16 genera are endemic.

The contrast between the Homoptera and Heteroptera is therefore very great, and one might say that the former, having a much smaller stock of ancient immigrants to start with, has been far more successful in species-formation than the latter. Even making all allowance for corrections and for additions to the fauna, this fact will certainly remain true.

Cimicidae.—The Cimicidae are very poorly represented by the one genus *Oechalia*, of which the Hawaiian species are considered to be sub-generically distinct from the typical Australian form. The number of species existing in the islands cannot be considered as definitely settled at present. Two only are readily distinguishable, but others will probably prove to be distinct. *O. grisea*, as now considered, presents extreme variation in colour and structure, and of these varied forms it is likely that some are in reality good species, and may themselves prove to be less variable than *grisea*, as appears to be the case with the second species, *O. kaonohi*, lately described. At any rate the nymphs present noticeable differences, and, so far as my limited experience goes, similar nymphs have not produced adults varying in any very important manner. *Oechalia grisea* is one of the commonest Hawaiian bugs, and occurs even on the hottest and driest coasts, when the vegetation is green, and above the upper limits of the forest on the high mountains. It is, however, most abundant in the forest-belt, and eggs, nymphs, and adults may be found on all kinds of trees, as well as on ferns and low plants. It has even been found breeding in gardens in the town of Honolulu. Its chief food seems to be caterpillars, especially those of the genus *Scotorythra*, but those of a good many other groups are also attacked occasionally, e.g. *Plusia*, and various Pyralidina. During the excessive multiplication periodically of looper caterpillars, *Oechalia* sometimes becomes also excessively numerous, and we have then seen eggs, nymphs, and adults in countless numbers on the forest-trees. During the worst years of the attack of the leaf-hopper of the sugar-cane (*Perkinsiella*), in some localities, in cane-fields adjoining the forest, numbers of *Oechalia* were to be seen in all stages preying on the hoppers, and both species of the genus were present.

During a visit to Australia I only noticed occasional specimens of *Oechalia*, and do not know whether, though known to become very numerous, it ever occurs in such great numbers, as its Hawaiian congener, nor whether it exhibits the same structural variability. It is proper to say that in certain localities it is quite possible to collect a fair series of the Hawaiian species, that does not show much variation. Dark metallic green forms of *grisea* with blunt spines seem mostly to occur in wet localities at moderate elevations, and have been noticed especially in the West Maui Mountains and on Haleakala.

THYREOCORIDAE.—*Geotomus pygmaeus* is probably an introduced species, though it would be of some interest to compare its variation with that of specimens from other countries. It frequents open country, and is often found under stones, and thrives in dry, hot localities near the coast, as well as in open spaces in the high forest, in the regions where frosts occur. Nymphs are found in company with the adult at the roots of herbage or beneath rocks.

Coleotichus blackburniae is the sole representative of the Scutellerine group, and is by far the most showy member of the Heteropterous fauna. It is not known from elsewhere, but its congeners are conspicuous in Australia and the Moluccas. Apart from the fact that it is the finest Hawaiian bug it is interesting, in that it appears to have two forms, usually distinct at a glance, the one appearing red, the other yellow. It is very widely distributed, and is found in hot, dry localities near sea-level, and in the mountains to five or six thousand feet above the sea. I have bred specimens from nymphs found in a garden in Honolulu. Both adults and nymphs are frequently gregarious, lying packed close together, when at rest. Great numbers are sometimes in consequence found together, and a single tree may hold some hundreds of specimens of adults and nymphs of all sizes, as well as many eggs. The adults appear to be on the wing at night, and occasionally enter houses, attracted by the light. However, they take flight very readily on slight disturbance in the daytime, especially during hot sunshine, usually flying a short distance, and making a loud humming noise as they fly.

Sometimes after a short circular flight they return to the tree from which they were disturbed. They are very partial to Koa trees (*Acacia koa*), but feed, so far as I have observed, only upon the pods of these, extracting their juices. Whether they will attack other parts in the absence of pods is very doubtful. They breed likewise very freely on a very different tree, *Dodonaea viscosa*, and both eggs and nymphs are occasionally found on other plants. The two mentioned trees are, however, their favourite food-plants. They have also been found breeding on imported Acacias. Usually from *Dodonaea viscosa* I have obtained the yellow form, with clear yellow dorsal stripe, untinged with red, from *Acacia koa* the red form. Whether these varieties depend entirely on the food-plant is, however, uncertain; it is perhaps more likely due to climate, the yellow variety being chiefly found in the driest localities. It is a remarkable fact that the little Lycaenid butterfly, *Lycaena blackburni*, which holds a position in the Hawaiian Lepidopterous fauna somewhat analogous to that of *Oechalia* in the Heteropterous, feeds either in the pods of *Acacia koa*, or on the *Dodonaea* with equal readiness and, so far as is known, on no other native trees. The small, globular nymphs of the first stage are very conspicuous objects from the strong contrast of their colours, the abdomen being for the most part bright red.

Lygaeidae.—If some doubt is attached to the endemicity of *Coleotichus*, this is also the case with *Ithamar hawaiiensis*, which likewise is only known from the islands. It abounds on the coasts of some of these, especially frequenting species of *Sida*, is common on the lower edge of the forests in open shrubby places, at 1500 to 3000 ft. above the sea, and again in open places in still higher forest, and far above this to a height of 9000 ft. At higher elevations it breeds on *Cyathodes*. Apparently it exhibits no noteworthy variation in any of these stations. Nymphs in all stages, eggs, and adults are found together on the plants named. The adults frequently wander elsewhere in their flight, and I have taken them in my garden in Honolulu. The hairy nymphs undergo conspicuous changes in the course of their development. This is probably the species that Blackburn supposed might be *Dysdercus peruvianus*. The only other Lygaeid represented in the islands—*Rhopalus hyalinus*—is certainly an introduction. Though common in Honolulu it was not obtained by Blackburn thirty years ago. It is polyphagous, and its eggs and young are familiar objects on the plants of *Sonchus*. The eggs are parasitized by two species of Proctotrupoids, *Telenomus rhopali* and *T. paractias*.

Myodochidae.—With this family we come to an extensive and important part of the Heteropterous fauna. The genus *Metrarga* with its two sub-genera is peculiar to the islands, so far as is known, and, moreover, forms an endemic sub-family. The number of species is at present uncertain, as those belonging to the typical sub-genus are apparently very closely allied. Excepting in size there does not seem to be much variation. In four species of the genus (sensu lat.) the variation in size is quite marked, by the occurrence of unusually small examples. These are taken actually in company with the larger examples. In *M. contracta* an interesting variety occurs in which the hind part of the pronotum is very conspicuously pale, so that superficially it greatly resembles typical *M. nuda*. It is apparently of rare occurrence, four in more than 50 examples of the normal form, all taken in company, were observed on one occasion. *Metrarga villosa* has the wings reduced to such microscopic rudiments as to be practically apterous, though the tegmina extend to the tip of the body. The other species are well winged.

The winged species are often notably gregarious, a dozen to scores congregating together at the base of the leaves of a single plant of *Freycinetia*. The nymphs occur in the same situation, sometimes mixed with the adults. These winged species may also be found on the ground amongst dead leaves or fragments of fern fronds, while the flightless *M. villosa* seems to have taken entirely to a terrestrial life, and perhaps became flightless in accordance with these habits. It is remarkable that amongst large flocks of one of the winged species (e.g. *contracta*) one or two examples of another species (*nuda*) are sometimes found, so that the flocks are mixed. The odour of the species is disgusting, when a colony is disturbed, and taints the surrounding air. While the representatives of *M. nuda* that are found on Hawaii, Oahu, and Maui are very similar, it is noteworthy that the Molokai form, although of precisely similar habits, is more distinct in appearance superficially.

The two species of *Orthoea* are of small interest, both having been certainly introduced; one of them, *O. nigriceps*, was already abundant more than thirty years ago, the other, *O. vincta*, appeared in 1900, and is already one of the commonest of Oahuan Hemiptera, and has now extended its range to the mountains. The latter is attached to the common foreign grass, *Cynodon dactylon*, amongst which nymphs in all stages abound amongst the adults. In the youngest nymphs the femoral armature is little or not at all developed. Brachypterous specimens occur in company with the macropterous. I have found nymphs of this or an allied genus, when inspecting plants imported from Fiji.

Clerada apicicornis is a semi-domestic species, living and breeding freely in dirty houses and cupboards, where cockroaches are allowed to multiply. It also occurs in outhouses frequented by bed-bugs. On the other hand it can adapt itself to diverse conditions, and I have noticed adults and nymphs in numbers in dry sandy localities, living with various common cockroaches, especially *Periplaneta*, *Euthyrrhapha*, etc., beneath dead leaves. Curiously enough in the mountains it frequents the bases of the leaves of *Freycinetia*, like *Metrarga*, and was once found by me in company with these. *Sephora criniger* is a local but common forest insect, found on various trees, while *Nesocymus calvus* lives on sedges, nymphs and adults occurring together, often in great numbers. The latter may prove to be not endemic, though it is now widely distributed in the mountains, and is found on Hawaii as high as 4000 ft. above the sea, in open places in the forest amongst low sedges. Brachypterous forms do not seem to occur. *Nesomartis psammophila* frequents sandy places, on or near the coast, living on low grass, or on the ground beneath, with its nymphs. In the larger of these the head is not produced far beyond the sides of the pronotum, as in the adult, but is of ordinary form. The youngest nymphs are remarkable for their shining black head and thorax, with white mediodorsal line. The species will probably be found elsewhere, and prove to be a natural immigrant.

The species of the genus *Nysius* form a large and important part of the Hawaiian Heteroptera, and no doubt many remain to be discovered, the disgusting odour that they emit rendering them unpleasant objects to collect. Some of the species occur in vast numbers. A small tree will sometimes furnish a home for hundreds of individuals, adult and nymphal, of *N. saundersi*, and others are equally common. It is not clear to what extent the different species are attached to particular plants. Some, which I had supposed to be confined to a single species of tree, I have on another occasion found in numbers on a totally different plant, belonging to some family far removed from the other. Some seem habitually to frequent for choice the dead or decaying branches of the tree they inhabit, others the flowers, and many the leaves or any other part. Many frequent low plants or ferns. No doubt there are numerous species that are very closely allied one to another, and as there is manifestly very great variation in the individuals of some of the species, a thorough knowledge of the genus in the islands will require prolonged study. It is likely that the actual differences between mere variations of some species will prove to be apparently much greater than the true specific differences between the most nearly related, but really distinct, species. The variable *N. blackburni* was noticed at Kilauea, Hawaii, feeding in little groups of several together on the droppings of mynah birds. These birds at the time were feeding on the fruit of an imported raspberry. Some species are at times met with living gregariously at the base of the leaves of *Freycinetia* like the *Metrargae.* The Hawaiian series exhibit great differences in important characters in their extreme forms. It is possible that one or two may have been imported with foreign plants.

Merragata hebroides, found on ponds near Honolulu and elsewhere, occurs also high up in the mountains of the other islands, and is known also on the American continent, being apodemic.

NABIDAE.—Represented in the islands by a large number of species of the genus *Reduviolus*, one of which, *R. innotatus*[1] White, I am told by Mr Kirkaldy, is apodemic and widely distributed. The other species form two groups, each of which contains numerous closely allied forms, but the connection between these two groups is not

[1] Since identified as *R. capsiformis*.

obvious. *Reduviolus oscillans* is typical of the first of these groups, and *R. lusciosus* of the second, the latter with its allies forming the sub-genus *Nesotyphlias* of Kirkaldy. *R. oscillans* and its near allies are all macropterous and exhibit little or no individual variation in the development of wings and tegmina and the ocelli are perfectly formed. In *Nesotyphlias* on the other hand the wings are reduced to extremely minute lobes, the tegmina are hard and leathery, with the membrane always reduced, and the various forms exhibit very great specific differences in the amount to which the tegmina are shortened. The wings do not, so far as I have been able to examine the species, vary in size in accordance with the difference in the size of the tegmina. Thus *Nesotyphlias lusciosus* with its tegmina forming a perfect abdominal covering, and with much larger membrane, has the same small, almost microscopic wings, as such a species as *N. curtipennis*, the tegmina of which fall far short of the apex of the abdomen.

There is, however, one species of Hawaiian *Reduviolus*, and that one of the commonest and most widely distributed of all, which differs from all the others, in having brachypterous and macropterous forms, as well as somewhat intermediate conditions. It was described, no doubt from macropterous examples, by White, as *R. blackburni*, there being no brachypterous specimens in Blackburn's collection. Blackburn's specimens were such as are usually found in drier localities or at lower elevations; truly brachypterous forms inhabit wetter localities or higher elevations in the mountains. I have taken some pains to observe this species at high elevations above 4000 ft. in the mountains, where I have seen it breeding in numbers amongst low sedges. In the most brachypterous form the membrane is much reduced in the female, the tegmina not quite covering the abdomen, while the wings are much shorter, though extending somewhat beyond the middle of the abdomen. It will be seen, therefore, that although the tegmina have suffered a reduction fully as great as in typical *Nesotyphlias lusciosus*, the condition of the wings is entirely dissimilar, nor have the ocelli suffered any apparent degradation. There is therefore a very great gap between *Nesotyphlias* and the forms of *R. blackburni*, which form as it were a faint lead to the condition of this always flightless sub-genus. In one other respect, in which *Nesotyphlias* differs greatly from the fully-winged Hawaiian *Reduvioli*, *R. blackburni* does make an approach to the former. Most of the winged forms have the pronotum much widened posteriorly and this widened part, when seen in profile, is considerably raised above the anterior portion. In *Nesotyphlias* this condition is exactly reversed, the front part of the pronotum being convex and raised above the posterior part. *R. blackburni* in its macropterous form is one of the few Hawaiian species, in which the hind part of the pronotum is but little raised posteriorly, the profile of anterior and posterior parts being about on the same level. In the brachypterous specimens the condition of the pronotum is variable, but in many of these it is distinctly convex anteriorly, and posteriorly is sunk to a lower level, in the same manner as in *Nesotyphlias*. It should be noted that the external copulatory organs of *R. blackburni* are notably different from those of the other *Reduvioli*, whether of the fully-winged group or of the flightless *Nesotyphlias*. It is quite possible that new species will be discovered connecting the well-winged forms of *Reduviolus* more closely with the flightless *Nesotyphlias*, and such a discovery would be of considerable interest.

As in so many other Hawaiian genera containing many species, *Reduviolus* presents a series of forms mostly very closely allied and sometimes more or less difficult to discriminate; some, indeed, without minute and careful study in the field it will be impossible to fix as being certainly good species or only variations. Amongst these occur a few forms, notably distinct and separable at a glance, though manifestly allied to the others. Many of the species exhibit considerable variability not only in colour, but in such characters as the shape of the pronotum, the thickness of the basal joint of the antennae, etc. Such variations occur in individuals of a species taken in company. It is noteworthy that whereas *R. blackburni* varies in the condition of tegmina and wings, being apparently affected by temperature or humidity or both combined, other species, such as *R. oscillans*, which are found under conditions, as diverse, seem to be nowise affected by these conditions.

The variety of *R. kerasphoros* with flavescent tegmina on the basal part is interesting, as nearly reproducing the colour pattern, that is, so far as we know, fixed as a specific character in *R. sharpianus*.

On Oahu I have made some attempt to study the habits of two forms of the flightless *Nesotyphlias*, which are very similar, with a view to deciding on their distinctness as species. On the whole their habits seemed to confirm their distinctness, seeing that though both might be found under apparently the same conditions, the one would also thrive in situations never occupied by the other. Thus though to some extent alike in habits, in others they differed, and this partial difference in habits was always accompanied by a definite difference in structure.

The habits of the Hawaiian *Reduvioli* are of considerable interest, for whereas some apparently have their habitat solely on one kind of tree or plant, others are less particular in this regard. It is noteworthy that the species, that are attached to a single kind of plant, are invariably of very distinctive superficial appearance. In determining the true habitat of a *Reduviolus* attention should be paid only to the trees or plants affected by the nymphs, because in the fully-winged forms, which fly sufficiently well, though weakly, individuals occur casually on plants, with which they have no real connection. *R. kahavalu* attached to *Sophora chrysophylla*, *R. tarai* on *Cyathodes*, and *R. truculentus* on *Pipturus* are good examples of the restricted habitat. The *Reduvioli* being carnivorous, it might be supposed that the restricted habitat of the species just mentioned (and of others to which I have not paid special attention in the field, in order to observe them *in situ* on their favourite plant) was due to the fact that these special plants furnished a special prey. This I believe not to be the case, but the association is rather for concealment, since either in the nymph or adult or in all stages these bugs of restricted habitat most closely resemble parts of the plants on which they are found.

Others that have not so special a habitat, yet often occur in their greatest numbers in situations, which best serve to conceal them. I have observed scores of *R. oscillans*, in all stages, on dead or dying fern fronds with which their colours harmonized very well.

The flightless species of the sub-genus *Nesotyphlias*, are much more terrestrial in their habitats than the others, some in fact, so far as is known, live entirely on the ground. They ascend ferns especially, on occasion, but are not at all arboreal as the fully-winged group are.

The nymphs of *Reduviolus* are not as a rule of particular interest; the basal antennal joint, which usually becomes much more slender in the adult, than it was in the nymph, in *R. kerasphoros* increases in thickness in the adult, in which also the processes of the head become much larger than in the penultimate stage. In young nymphs these curious horns are absent.

The Hawaiian *Reduvioli* prey upon small and weak insects and we have never seen them attack Coleoptera, as the introduced *Zelus* does. It is probable that the comparative feebleness of their mouth parts would render this impossible. They are commonly found on such plants, as are the home of small Delphacid leaf-hoppers, on which they are well known to feed, while some of them eat also the honey-dew or sweet excretion that is produced by the hoppers. They have been seen sucking the juices of Psocids and it is probable that these form an important article of diet of several species. The imported leaf-hopper (*Perkinsiella*) which did so much damage in the cane-fields, was attacked to some extent both by *R. capsiformis* and *R. blackburni*, both becoming common in some of the affected fields.

The eggs of *R. capsiformis* are destroyed by the Mymarid parasite, *Polynema reduvioli*. In 1902 leaves of melon plants, very badly attacked by an *Aphis*, were sent to me for inspection, and on these were many nymphs and adults of *R. capsiformis*, preying on the plant-lice. The eggs of the *Reduviolus*, however, had become very highly parasitized by the *Polynema*, very few young bugs appearing. Embedded in the leaves of grasses and of the sugar-cane eggs from which parasites have escaped are found not infrequently. Probably the eggs of species of the terrestrial, flightless sub-genus *Nesotyphlias* will likewise, when discovered, be found to yield a Mymarid parasite, for a large *Polynema* is constantly observed flying over the earth, in the damp dark haunts of these insects. Further it is possible that these parasites are a strong check on the multiplication of Hawaiian *Reduvioli* in general.

Gerridae.—A family of small importance represented by two genera, each with a single species, one of which, *Halobates sericeus*, is of very wide distribution, and has been seen on the sea round various parts of the coast of several of the islands, and no doubt occurs round all. I have seen *Halobates* in great numbers, when I have been sailing round the coast of Hawaii near Kawaihae, but never had an opportunity of collecting specimens.

Microvelia vagans is an abundant species and widely distributed in the islands, from the coast to high mountain elevations. It frequents both stagnant pools and running water, often in great numbers, and after heavy rains is sometimes seen even on the temporary puddles in the roads round Honolulu. It flies by night and occasionally is attracted by lights. Possibly it will be found elsewhere and is a natural immigrant, though it may have been of early introduction in the water supply of sailing vessels. It exhibits considerable variability in colour, but this has not been specially investigated in reference to different localities.

Reduviidae.—This family is represented by endemic species of the Ploiariianae and three imported species of other groups, none of the latter being found in Mr Blackburn's collection. One, indeed, *Zelus renardii*, was introduced about 1897, when I observed one or two specimens, including a female by the side of its egg-mass, at Honolulu in the Government Nursery, where plants were introduced and raised by the Board of Agriculture for general distribution. By 1900 it had become fairly common in Honolulu, and three years later extremely so, and had spread to all the other islands. It preys on very different kinds of insects, and the adults will destroy many kinds of beetles, such as Dermestids, Coccinellids and Tenebrionids, and even the hard Hymenopterous genus *Chalcis*. The young feed on softer creatures, especially *Aphis*, young leaf-hoppers, etc., which are also attacked by the mature bugs. Although destroying an occasional lady-bird, when well-grown, yet the main food of *Zelus*, as an adult, consists of injurious insects or at least of such as are not beneficial, while the young prey almost entirely on injurious species. Consequently, on the whole, *Zelus* does far more good than harm.

Triatoma rubrofasciata has several times been found in houses or outhouses infested with cockroaches or bed-bugs. *Allocoeranum biannulipes* has only occurred once. The endemic genus *Nesidiolestes* is said to be allied to *Luteva* and *Ploiariodes*, the other two Ploiariine genera represented. The species are terrestrial and have been found in company with the flightless *Reduviolus*. *Luteva* and *Ploiariodes* prey on Psocidae; a species of the former is occasionally found in houses in Honolulu. The number of species of the latter is at present uncertain; they are usually found on dead branches of trees, to which the dry leaves are still attached, and on dead fern fronds, whereon their prey is numerous.

Anthocoridae.—This family is represented by a small number of species scattered in half-a-dozen genera and although these species are all, at present, known only from the islands, it is uncertain whether several of them are not really introductions, their small size, and unattractive appearance rendering them liable to be overlooked in tropical countries, or at least neglected by the collector. Three of the species occur in gardens in Honolulu and two of these are widely distributed outside, but they cannot be looked on as forest insects. All three are found in the cane-fields. These are *Triphleps persequens*, *Physopleurella mundula*, and *Buchananiella sodalis*. The first-named will I think almost certainly prove to be foreign. It is partial to flowers, e.g. those of *Lantana camara* and preys on the Thysanoptera (introduced) that are found in these. *P. mundula* and *B. sodalis* are sometimes found in company, the former being especially common, sometimes occurring in countless numbers, as in the cane-fields at Paauhau in 1903, hiding amongst the dead cane-leaves, where it preyed largely on Psocidae and small leaf-hoppers. On the leaves of growing trees or shrubs, such as crotons, oranges, mulberries, etc., the conspicuous red nymphs and mature bugs are often found beneath the webs made by the Psocidae, which feed on the black fungous growth, that springs up on the excretions of various scale insects infesting these trees. One may find at such times a small flock of Psocids resting side by side with their enemy, beneath the covering made by the former. Both *P. mundula* and *B. sodalis* may be found in decayed stems of plants, where, I believe, they feed on Thysanoptera, which are found in this situation. Yet another small Anthocorid, at present undetermined, has the same habits, and this also was present in the islands at least thirty years ago. *P. mundula* exhibits considerable variability or I would rather say that, until careful examination has been made, I do not feel sure that there is not more than one species of its genus.

Lasiochilus denigratus and its allies are true forest insects and live beneath bark or in the cavities of dead twigs or stems, the nymphs being found in the same situations. The specific characters appear to be feeble and uncertain.

Lilia dilecta is also a forest insect and the genus is endemic. I have not met with it, or at least neglected to collect it. I regret that I neglected to collect specimens of one or more forest-dwelling Anthocorids, distinct from any of these.

Miridae.—The Miridae, better known to entomologists in general as Capsidae, are represented by a greater variety of endemic forms than any other family of Hawaiian Heteroptera. Eleven of the genera are endemic. Two recorded species are certainly recent introductions, an undetermined species of *Fulvius* (I believe the same species as one I met with while inspecting introduced plants) and *Halticus chrysolepis*, abundant in Honolulu gardens, where macropterous and brachypterous forms occur together, the latter having mere rudiments of wings. Even so late as the early part of 1909 single specimens representing two other genera of Capsidae, have been found in Honolulu. These imported species are of very little interest, but their occurrence renders it likely that one or two other Hawaiian species, not known from elsewhere, may have been imported with plants at an earlier period. At the most three, however, are open to suspicion. *Oronomiris hawaiiensis*, a very abundant species on foreign grasses, occurs everywhere in suitable places, from the coast to 5000 ft. or more on the higher mountains. This will, I think, almost certainly be found outside the islands, though possibly a natural immigrant. *Hyalopeplus pellucidus*, so common in the gardens in Honolulu, a doubtfully endemic species, is also ubiquitous in suitable localities, and is chiefly attached either to foreign plants, or at least to such as are not endemic, but it is polyphagous. In Honolulu it is mostly found on the hedges of imported *Hibiscus*; on the lower slopes it breeds, often in profusion, on the imported guava; in the high mountains, at four thousand feet and upwards, it is no less common in all stages on *Dodonaea viscosa*, a native tree or shrub, that is apodemic. Whether in general the species of *Hyalopeplus* are variable I am ignorant, but *H. pellucidus* exhibits notable variations of a melanochroic character. These appear to be mostly found in wet localities or at high elevations, where specimens for the most part smoky black are found, in some cases at any rate mixed with those of ordinary colour and intermediates. Like *Oronomiris*, the genus *Opuna* was formed for a small and obscure Hawaiian insect. It is attached to a species of *Sida* that is not endemic, and it will probably be found elsewhere. *Sulamita* is an endemic genus, and forms an endemic division or tribe of the Miridae, several very closely allied species being known. They frequent the endemic forest trees (of various kinds) from 2000—5000 ft. The species of *Tichorhinus* (*Orthotylus*) are numerous, and of universal occurrence throughout the mountain forests of all the islands, and certainly many, and probably all the species are numerous on occasion. They are, however, very frequently extremely unevenly distributed in some forests, so that, while one or more trees of a certain kind may contain many, sometimes in fact hundreds of specimens of a species, other trees of the same kind in the neighbourhood will produce few or none.

Some of the species are polyphagous and found on very different trees, and can thrive, moreover, at very different altitudes. Thus *T. iolani* may be found on an endemic *Hibiscus* on the dry forehills, in some of the wettest low-lying valleys on other native trees, as well as on an apodemic *Hibiscus*, or yet again above 4000 ft. on the high mountains on other endemic trees. Such extreme cases are, however, exceptional, and some species are, so far as we know, quite constant to a single kind of tree. Thus one of the smallest species, of green and black colour (allied to *T. kanakanus*), is one of the commonest insects that are attached to *Pipturus albidus* in the mountains round Honolulu. Another minute red species, lives on *Cyathodes* on the high mountains of Hawaii, in company with the several other Rhynchotal insects, that habitually frequent that plant.

Some of the species exhibit much variability in colour, and as the structural characters (unless the male genitalia should prove to be of value) appear in general to show very slight specific distinctions, it is not always easy to define the limits of the species. A general variability is exhibited by individuals taken in company, and moreover there is evidently local variability as well. Though small, some of the species are really pretty insects. The nymphs are often abundant on the under side of the leaves of the trees, in company with the adults. Unless disturbed by shaking, very rarely are any of the latter seen on the wing.

Koanoa, with one recognized species only, is almost universally distributed in the forests of all the islands. It appears not so much to frequent leaves as the woody parts of trees and is often taken on dead branches, when one is collecting beetles. *Kamehameha lunalilo*, a species exhibiting some variability, is chiefly to be found in damp forests, living on the mosses or creeping ferns, which clothe the trunks and branches in such situations. Consequently it may be obtained from many kinds of trees by indiscriminate beating of the branches.

The *Cyrtopeltis* (*C. hawaiiensis*) was obtained from a shrub or tree, not noted at the time, but probably *Dodonaea*, at a high elevation, 8000 ft. or more, on Haleakala. An apparently allied form is very common in the mountains round Honolulu, living, in all stages, beneath the leaves of *Gouldia*.

The small flightless *Nesidiorchestes*, in which the wings are absent, is terrestrial, living chiefly in damp shady places, where the soil is more or less covered with decaying leaves. Sometimes it is seen in numbers in company with the flightless Nitidulid beetle, *Apetinus explanatus*, and the flightless Dolichopodid fly, *Emperoptera*, and young of the flightless crickets (*Paratrigonidium*), which it slightly resembles in appearance.

Pseudoclerada morai is a remarkable insect, exhibiting conspicuous variation. Some of these varieties, however, may prove to be closely allied species. There is great sexual difference in the development of the eyes, and brachypterous forms occur. The species inhabits damp shady places in the forest and has been found beneath bark of dead branches of trees, and also amongst the moss or creeping ferns growing on these. Like *Metrarga*, they hide at the bases of the leaves of *Freycinetia*, where rubbish accumulates. They may possibly prove to be predaceous.

In the genus *Sarona* there are a number of forms, the extremes differing greatly in size and colour, but apparently showing little or no distinction in superficial structure. In most localities on Oahu they are rare, but in parts of Hawaii occur in great numbers, frequenting the leaves of various forest trees. On one occasion I examined a large number of specimens from *Metrosiderus*, and found great variability in size and colour, while close by on a species of *Raillardia* were many specimens, small, black, and hardly at all variable either in size or in colour. On Oahu, near Honolulu, they are to be found on *Pelea*, and I think these Oahuan specimens do not vary much, nor do they visit the trees of *Metrosiderus*, in the neighbourhood of the *Pelea*. Unless new characters for specific distinction are discovered, the number of species that exist will, I expect, remain very uncertain. The largely developed hooks of the male genitalia may prove of use for distinguishing the species.

Kalania hawaiiensis is allied to the preceding and resembles it in habits, and in fact occurs with it on the island of Lanai. Though recorded only from that island, it may not improbably be found on Molokai or Maui or on both of these islands.

Acanthiidae.—There are two distinct forms of *Acanthia*, and each of these exhibits striking variation, or it may be that there are several closely allied species related to each of these two forms. However that may be, there is certainly great variation in individuals of a single species in superficial appearance. The diversity of habits shown by these Hawaiian species is of considerable interest. Both frequent the margins of mountain streams, but are found quite away from these, running on the ground in damp shady places, in thick forest. They are also at home in damp rocky places in open parts of the mountains. On one occasion on Hawaii, when climbing a tree to collect certain species of beetles, I found two or three specimens of *Acanthia* running on the trunks, high above the ground, a habit, as Kirkaldy informed me, quite unique. Curiously enough two of these arboreal individuals, taken together, had no superficial resemblance to one another, though, I think, clearly of one species, nor do they differ from examples found running over a wet, rocky cattle trail on Molokai, where the insect showed similar variation. It is a remarkable fact that while in some localities a number of individuals of *Acanthia* may be taken together and show no great variation, in others, individuals will occur, which differ very greatly amongst themselves. Nymphs are often met with in the same localities as the adults, sometimes in greater numbers than these, from which they differ greatly in head and thorax, the former with the eyes being only about as wide as the front margin of the latter and closely adapted to this. Both *A. exulans* and *A. oahuensis* are flightless, the wings of the former being much smaller and shorter than the tegmina and reaching about to the middle of the abdomen. Those of *A. oahuensis* are still further reduced, and there is evident variation in examples from different localities, which may possibly be specific.

Corixidae.—This family is represented only by *Corixa blackburni* White, a species not known from elsewhere. It is very widely distributed on the lowlands of the islands, inhabiting salt-water pools as well as ponds of fresh water. It comes to light at night sometimes in considerable numbers.

Notonectidae.—Represented only by *Buenoa pallipes*, a foreign species. It is equally abundant near sea-level and in ponds on the mountains at an elevation of at least 3000 ft., being generally distributed.

Hemiptera-Homoptera.

The Hemiptera-Homoptera of the Fulgoroid and Jassoid superfamilies are no doubt more numerous in species than the Heteroptera, owing to the fact that several of the genera have evolved great numbers of allied species, of highly specialized habits, in so far that they are restricted, many of them, to a single food-plant, and can only live in those stations, where these special food-plants flourish. Moreover on different islands, even when living on a similar food-plant, the species may be quite different. In the present state of our knowledge we can say that the vast majority of the known species have so far been obtained only from one kind of plant, but that a few are able to live on quite different kinds of trees. Nearly all are attached either to trees or shrubs or to various species of ferns, and the fauna contrasts most strongly with others, where there is usually such a varied assembly of forms frequenting grasses, sedges, etc.

It is interesting to compare the components of these Homopterous groups with those given already in the Heteroptera, excluding in each case such forms as are either known to be foreign or are likely to prove so. Only *Nysius*, *Reduviolus* (s.l.) and *Orthotylus* can be compared with the more extensive genera of the Fulgoroids and Jassoids as successful producers of species, and only a few of the *Nysius* and a few species of Capsids, as equally successful producers of individuals.

Poekillopteridae.—A single species representing this family, *Siphanta acuta*, is of recent introduction, having appeared first about 15 years ago. It is a common Australian insect. By 1900 it had become so extremely numerous, that in some of the forests on Oahu it was actually destroying large numbers of certain native trees, besides being injurious to coffee and other cultivated plants. A Proctotrupoid egg-parasite (*Aphanomerus pusillus*), introduced by Koebele and myself in 1904, has done excellent service in many localities in diminishing the numbers of this pest. In wet districts it frequently is destroyed by a parasitic fungus.

Fulgoridae.—This family is represented by only two genera, and one of these, *Iolania*, which is endemic, contains but a single species. It is very variable in markings and intensity of colour, and is partial to ferns, on the trunks of which it may be frequently seen resting.

The other genus, *Oliarus*, contains a score of species, some of which are quite conspicuous and striking insects amongst their congeners. Many of the species are variable in colour and markings, considerable variability being exhibited by examples of a species taken in the same locality, and there is evidently further variation due to different local influences. In addition to general variation, there is in many species striking sexual dichromatism, so that the one sex of a species may sometimes bear a greater superficial resemblance to another species than it does to its own partner.

Consequently the separation of the numerous species is attended with considerable difficulty, very few apparently being notably distinct from their nearest congeners.

Some of the smallest and most obscure forms are strictly attached (e.g. *O. kaonohi*) to tree ferns, in the cavities of the stems of which, especially when they are fallen and more or less decayed, the nymphs are found living gregariously. Most of the finer species, however, are attached to various forest trees, and of some of these the nymphs live beneath the bark, sometimes in large flocks, sometimes associated with the adults. In such situations the amount of honeydew excreted, not being exposed to sun or wind, accumulates in extraordinary amount. Apparently several of the species are entirely restricted to one kind of tree (e.g. *O. tamehameha* on *Metrosiderus*) but the observations on this point are not conclusive, since they have not been made in sufficient numbers, nor in sufficiently numerous localities. Of these more conspicuous arboreal forms the apparent scarcity of many is, doubtless, more apparent than real, for we have observed some of these in considerable numbers on the trunks or stouter branches of the smaller-sized forest trees, on which they run with considerable quickness, and with the rapid sidling movements of the larger Fulgorids of other countries. In such circumstances they do not readily admit of capture, and if the branches be jarred, the majority of the individuals no doubt escape, their strong jump combined with flight carrying them beyond the limits of any receptacle held beneath. Though of universal occurrence, where native insects are found, they will probably be found most richly represented in wetter forests, with very heavy rainfall. One species at least, a small and prettily marked one, lives on a liliaceous plant (*Astelia*), growing in abundance around the volcano house at Kilauea on Hawaii.

Asiracidae.—Excluding two or three genera, the species of which are either certainly introduced or possibly natural immigrants, the six endemic genera of Asiracid (often known as Delphacid) leaf-hoppers form a remarkable assemblage of allied forms, notable for the similarity of structure in the jumping spur of the tibiae. There is little doubt, I think, that they have originated from the same ancestral immigrant, the generic divisions of the present-day assemblage having proceeded on lines quite similar to those followed by other genera of Fulgoroids in other parts of the world. At the same time the genera are very well marked indeed, as defined by Kirkaldy, though I anticipate that forms connecting some of these more closely, remain to be discovered. In this connection it is interesting to note that in the mountains close to Honolulu there occurs (at present undescribed) a form in which, though quite similar in general characters to other Hawaiian species, the frontal keels remain separate and well defined for half their length, in this respect being intermediate between *Aloha* and *Nesorestias* on the one hand and the remaining endemic genera on the other.

There appears to be no material difference in habits between the representatives of the different genera, considered collectively. After spending considerable time in observing Asiracid hoppers in Australia and England, as well as in the islands, one is struck with the difference in habits between the endemic Hawaiian genera and the others. A good many of the former are certainly attached solely to ferns, and so are some of the latter, but so far as is known, grasses, which elsewhere usually produce these insects in abundance, in the islands have not yielded a single species of the endemic genera. Apart from those frequenting ferns, nearly all are attached to various endemic trees, while one or two live on low-growing dicotyledinous flowering plants. *Aloha ipomoeae* is an interesting species, in that, although it follows the plants of *Ipomoea* into the forest region, it is also a true littoral species, frequenting the *Ipomoea pes-caprae* on sandy beaches. I think it highly probable that this species or others very closely allied thereto will be found on this widespread plant in other countries.

Many and probably most of the species of endemic Asiracid leaf-hoppers are attached to a single species of plant, while others affect very different species of the same genus of plant, as for instance *Aloha ipomoeae*, and *Nesosydne ipomoeicola* on various kinds of *Ipomoea*. On the other hand, even on the same island, two allied species may frequent the same or very closely allied plants in the same or very closely adjoining neighbourhoods, as two species of *Nesodryas* on *Gouldia* in the mountains just behind Honolulu. One of these moreover is found on more than one species of *Gouldia*. *Nesosydne gouldiae* has been found not only on *Gouldia*, but on a very different endemic genus of trees, breeding thereon. It is necessary to observe that in assigning hoppers to a particular plant one must consider only those on which they really breed, for adults of the winged species may be found on plants with which they have no real connection. When some nine years ago I first collected the small *Nesodryas freycinetiae*, it was noticed in numbers resting on a foreign weed on the lower edge of a forest near Honolulu and I suspected it of being a foreign insect. In reality these specimens had been beaten down by a violent storm, that occurred in the previous night, from plants of *Freycinetia* overhead, for on these alone are the nymphs found feeding.

Although many of the species of these leaf-hoppers occur in large numbers when found, yet they are often very irregularly distributed. In many cases scores of a species of plant may be examined and yield no hoppers, and then one will come upon one or several adjoining, on which there is a profusion of specimens. Some species are no doubt particular as to the condition of the tree they affect, as is the case with *Nesosydne koae*. The true leaves of *Acacia koa* are replaced by phyllodes and in most cases only the latter are found on well grown trees. Some, however, will yearly produce true leaves in abundance, and on such *Nesosydne koae* thrives in extraordinary numbers year after year, when it has become established. Surrounding trees, that bear phyllodes only, will rarely produce a few stragglers of the hoppers. Large phyllode-bearing Koa trees, which have an occasional young shoot bearing true leaves, will often have quite a colony of the *Nesosydne* confined to these shoots. One or two of the species are widely distributed over the islands, and at present it would be premature to consider that the many, known only from one island, are really confined to one, though no doubt this will prove to be the case in many instances. Nor is it probable that the genus [1]*Nesodryas*, consisting of small insignificant species, is really confined to Oahu.

As in other parts of the world, these Asiracid leaf-hoppers differ much as to the development of the wings according to the species. *Nesodryas* in all its species is fully winged. In *Nesosydne* some species are known, in which fully winged examples occur, but these are much rarer than the flightless individuals. I have certainly examined many thousands of the common *N. ipomoeicola* in search of parasites, both in the mountains and in the lowlands, where were colonies within a few yards of my house for several years, but fully winged individuals were rarely met with. For several consecutive days I examined for the same purpose great numbers of *N. raillardiae*, but I never found any but flightless forms. Still they may be produced at irregular intervals. *Nesosydne koae* and some others are only known as fully winged individuals, though the species named occurs in profusion.

In the genus *Aloha* the conditions are very similar to those in *Nesosydne*. In *A. ipomoeae* fully winged forms are rare as in *Nesosydne ipomoeicola*, though this species also has been examined in equal numbers for parasites. *A. lehuae* and its allies are always fully winged, but of *Nesopleias nimbata* it is unlikely that winged forms are ever produced, since the very short tegmina have become thickened and the neuration more reduced than in brachypterous *A. ipomoeae*. It would appear probable that in the various endemic genera, species, which we know from a fair number of examples of fully winged individuals, are not likely to yield brachypterous ones under any circumstances, while the normally brachypterous species sometimes produce fully winged individuals in small numbers, but more often are entirely brachypterous. We know no Hawaiian Asiracid, in which both winged and flightless forms are more or less equally common, no such case in fact as is presented by the two introduced forms *Perkinsiella saccharicida* and *Peregrinus maidis*. In the former of these winged examples are always common, and flightless females abound in the colder months of the year. In the latter both forms in both sexes abound at various seasons. *Nesorestias* contains a single species with very short tegmina, and is not likely to yield a winged form, the peculiar structure and texture of the tegmina being analogous with that of flightless Hawaiian Hemerobiids in the Neuroptera.

In the Hawaiian Asiracids it should be observed that, whether fully winged or flightless, both sexes agree in this. No species are known, which, like the introduced *Perkinsiella*, produce brachypterous individuals in one sex only. In the flightless Hawaiian forms the wings are reduced to microscopic rudiments, but can be seen in all the species that I have examined. There appears to be little difference between the

[1] More than one species of this genus is now known from Kauai.

largest nymphs of some of these flightless species and the same stage of fully winged ones, the tegminal and alar lobes being almost equally developed in each, so that in the species which produce both winged and flightless forms it would appear that the development continues equally in the nymphs of either to the penultimate instar, when in the one case a fully developed wing forms within the wing pad (on which some neuration is visible) while in the other case the wing is reduced to the rudimentary condition of the adult. The nymphs do not appear to be particularly interesting in general, the chief point of interest being the presence of two facial carinae in those which produce adults with only one.

Kirkaldy tells us that the only Asiracid known outside the islands, having a tibial spur similar to that of the Hawaiian endemic genera, is the arboreal *Proterosydne* of Australia.

The genus *Dictyophorodelphax*, discovered by Mr O. H. Swezey, is remarkable for the great prolongation of the head, a common feature in other groups of Homoptera, but not known previously in Delphacids. It is clearly an offshoot from the more normal Hawaiian forms.

Many of the species of the native genera exhibit a wide variability of colour, and further frequently the sexes are differently coloured. The males, however, are so easily separated by the great differences in the genitalia, that in the discrimination of the species this is of small moment. Whether there may be different species with similar genitalia is yet unknown, but it is not improbable that such will prove to be the case, when species from all the islands have been more thoroughly collected. The flightless forms are no doubt not easily spread from one locality to another, and I suspect that in many of these a good deal of local variation may be met with. I once examined two large series of *Nesosydne pipturi* from two different stations in the mountains behind Honolulu, where the species is very common. The first lot were taken from a number of trees, growing near together, in a rather open spot, the second lot from an isolated tree distant not many hundreds of yards from the former. Although possibly individuals might have been picked from each lot agreeing exactly, yet on the whole the two series were so distinct superficially, that until I examined the genitalia I had great doubts whether those from the isolated tree were not a really distinct species.

The eggs of some of the species are known to be destroyed by Mymarid parasites of the genus *Polynema* and nymphs and adults of very many have been found infested by the Strepsipteron, *Elenchus melanias*. In the mountains of all the islands many species are parasitized by a somewhat aberrant species of *Pseudogonatopus* (Dryinidae), this parasite attacking species of *Nesosydne*, *Aloha* and probably other genera. On the lowlands *Aloha ipomoeae* is attacked by *Echthrodelphax fairchildii*, another Dryinid, which likewise parasitizes the small *Kelisia sporobolicola*. This leaf-hopper is common on the coasts, feeding on the foreign grass *Sporobolus virginicus*, and two other species of *Kelisia* have also been found. Wherever these leaf-hoppers are found in the forests, and sometimes in the open country, one or more species of the parasitic flies of the genus *Pipunculus* will be found, sometimes numerously. I have bred two species from mixed colonies of *Aloha ipomoeae* and *Nesosydne ipomoeicola* and another from *N. raillardiae*. At Kilauea I observed many of these flies around a *Pipturus* tree, growing in a shady place, and infested by another *Nesosydne*, as well as about ferns affected by other species.

MEMBRACIDAE.—Represented only by a species of *Centrotypus*, of recent introduction. It was first taken in the Nuuanu valley in 1903, since which time it has occurred occasionally and will no doubt become common.

TETIGONIIDAE.—This family is represented by a large number of species, closely allied to one another, but forming two genera, one being, so far as is known, peculiar to Kauai, and at present containing few species. Excepting that *Nesophryne* (the small genus) sometimes occurs on ferns, all the endemic Hawaiian Tetigoniidae (of the extensive genus *Nesophrosyne*) are attached to flowering dicotyledinous plants, and the vast majority of the species frequent the various endemic forest trees. A few kinds only are attached to low growing plants, and one of these, *N. perkinsi*, is of some interest, as living on a foreign (but naturally immigrant) species of *Sida*, on or near the coast. The case of *N. perkinsi* as regards habits and food-plant and its relation to its forest-frequenting congeners is in several respects similar to that of *Aloha ipomoeae* in the Asiracid series.

It is quite certain that a large number of the species of *Nesophrosyne* are restricted to a single food-plant, and more than one species may occur on the same individual tree.

The separation of the species is at present attended with much difficulty, for many of them are very variable in superficial appearance and there is often a considerable difference in the colour or pattern of the sexes. It further seems to be of rather common occurrence, in the case of such species as present these sexual differences, for individuals of the female sex to assume more or less completely the colour of the male, a phenomenon which is also apparent in some of the Asiracid Fulgoroids. In addition to this, a colony of a species infesting one tree sometimes shows considerable differences in appearance, when compared with a colony infesting another tree, even though the distance between the two is small, and these differences are likely to be increased, when colonies from more isolated spots are examined. I have little doubt that any number of superficially distinct forms could be obtained by selective breeding. It is possible that the appearance of individual colonies is often due to the nature of the original parents that colonized the tree, for colonies, if undisturbed, persist on a single tree, as I have experienced, for years.

Many of the species are certainly common, in fact in some localities, e.g. on the uplands of Hawaii some of them occur in extraordinary profusion, hundreds or thousands having been noticed on a single tree.

Although the adults present apparently very feeble characters for specific separation, yet the nymphs by their bristles and ornamentation are often more easily distinguished. Consequently one may breed from nymphs of the most distinctive appearance adult hoppers that greatly resemble one another.

The superficially distinct species *N. ponapona* and *N. pipturi* are sometimes found on the selfsame tree of *Pipturus*, a very remarkable case, unless they be dimorphic forms of a single species.

The species of *Nesophrosyne* are subject to the attacks of a parasitic fungus, which, on the uplands of Hawaii, we have found, at times, to amount to a severe epidemic. On one occasion countless thousands of one or more species were to be seen sticking on the leaves of the trees, all dead, those in which the development of the fungus had not proceeded far, being still life-like in appearance. The eggs of these Tettigoniids are extensively parasitized by the Mymarid genus *Polynema*, but neither Dryinid nor Pipunculid[1] have been obtained from nymph or adult, in striking contrast with what occurs in other countries.

The other known members of the Jassoid group are of comparatively little interest, though *Limotettix* is, I think, certainly represented by truly endemic species. A species of *Conosanus* (*C. hospes*) extremely common in gardens in Honolulu is certainly introduced and of no interest. Its introduction is quite recent.

CHERMIDAE.—Better known as Psyllidae, these insects are represented by rather numerous species, in fact the gall growths formed by *Trioza* on the predominant tree (*Metrosideros*) of the Hawaiian forests are one of the most familiar entomological sights in the islands, while others on various species of *Pelea* are sufficiently common. Although these gall-forming species are so numerous in individuals, a number of species of *Hevaheva* with picturated tegmina occur much more rarely and locally, though no doubt the species are rather numerous. If they produce gall-growths, these have not yet been discovered.

APHIDAE.—The members of this family are of little or no interest faunistically, since probably all of them have been imported with introduced plants. In this connection however it is proper to state that formerly, 1892–1896, a species of *Myzus* (?) was very abundant throughout the mountains, especially attacking the species of *Pelea*, other species of Aphids being hardly met with in the forests at the earlier date. This *Pelea*-frequenting species seems to have been practically exterminated by the ladybirds (especially *Coelophora inaequalis*) introduced to diminish the attacks of foreign Aphids, on which *Coelophora* now maintains itself in the mountains.

[1] *P. rotundipennis* belonging to a different section of the genus from that including the other known species, may be parasitic on Tettigoniids.

Coccidae and Aleurodidae.—These families are of no importance in the present connection, probably all the many species of the former and certainly all the few representatives of the latter having been introduced with plants.

Review of Thysanoptera.

The Hawaiian Thysanoptera have so far only been collected casually, and of late years many introduced forms have become conspicuous around Honolulu and elsewhere.

So far as I can judge, the endemic fauna is entirely restricted to the Tubulifera and all the Terebrantia will prove to have been imported by man. Even of the former we may suspect that *Agnostochthona*, *Diceratothrips*, and possibly *Trichothrips* are represented only by foreign species, while *Anthothrips usitatus* is certainly an importation. This leaves us with only four genera, all peculiar to the islands, which at present must be considered as truly native. Three of the four genera, *Dermothrips*, *Oedemothrips* and *Nesothrips*, contain only a single species, while the other, *Dolerothrips*, has nine, and is evidently dominant in the islands. I believe that all the native species are attached to dead wood, flower-frequenting species being absent. All the specimens obtained by me were found whilst I was collecting beetles, and no special search for Thysanoptera was made. Individuals of some species are quite numerous, and they seem to occur everywhere in the mountain forests.

Review of Orthoptera.

At the present time the Hawaiian Orthoptera are represented by 83 species, 38 or 39 of which are certainly endemic, while 44 or 45 are apodemic and have mostly, no doubt, been introduced by man's agency.

The Phasmoidea are entirely absent from the fauna, while the Mantoidea are represented by two species of recent introduction and the Acridioidea by two foreign species, one of quite recent importation (1900) and one established here many years ago. These three great groups were therefore quite wanting in the fauna under natural conditions, though two of them now are represented by common foreign species brought accidentally with plants since the colonization of the islands by white men.

Hardly better represented are the Dermaptera, Forficuloidea or Earwigs and the Blattoidea or Cockroaches. Though there are seventeen species of the latter, now known as Hawaiian, one only has any claim to be considered endemic, a true forest insect, *Phyllodromia obtusata*. It is just possible that one or two other species are natural immigrants, but I think this unlikely.

The Earwigs are in nearly similar case, for while a few may be natural immigrants, we know that three or four species have become introduced within quite recent years. One, however, listed in this work as *Anisolabis pacifica*, will I think prove to be a distinct species and endemic or at least a natural immigrant.

Forficuloidea.—Of the genus *Anisolabes*, *A. annulipes* is the most abundant and ubiquitous, being found at all elevations from sea-level to four or five thousand feet in the mountains. [1]*A. maritima* is less abundant, but is very widely distributed and sometimes very common beneath stones in damp localities in the forest region. It also occurs near sea-level. [1]*A. littorea* is much rarer than either of the above. We have noticed it on the margin of salt-water ponds on the coast and it has been recorded from a considerable elevation (2000 ft.) in the mountains. The species recorded as [2]*A. pacifica*, but which will probably prove to be endemic, has been found only on Kauai, where it lives beneath logs or stones in or near the forest region. It was in company with the young of this species that *Japyx sharpi* was found, at an elevation of 4000 ft. *A. annulipes* and *A. maritima* are cosmopolitan species; *A. littorea* is a well-known New Zealand insect.

Labia pygidiata is a very common insect in the forests of all the islands, where it lives beneath bark, especially that of damp and decaying trees. Other species of this genus are of quite recent introduction and found on more than one island. Some of these are known to inhabit Samoa and Fiji, having been found on plants imported from those islands. *L. pygidiata* is reported from Java and Burma and is, no doubt, of wide distribution.

A fine *Labidura* (probably *icterica* Serv.) is now common on Oahu, under stones in damp places, and beneath trash in the cane-fields. Like many other foreign forms it was probably introduced with growing plants from the Oriental region, where it is widely distributed. It is spreading to other islands of the Hawaiian group.

Chelisoches morio is a very common insect, especially in the *Freycinetia*-growing belt of forest. It generally lives at the bases of the leaves of that plant and of such others as retain moisture, where they clasp the stem. It abounds in such situations on *Canna indica*, *Cordyline terminalis*, and in damp localities on the sugar-cane. Though many lie concealed during the day, others may be noticed running over the leaves of the plants they frequent at all hours. They are largely carnivorous, but also feed on vegetable matter, such as the red inflorescence of the *Freycinetia*. We have observed them devouring caterpillars and the sugar-cane leaf-hopper. They often seize and hold their prey in their forceps. *C. morio* is of very wide distribution, ranging from India to the Philippines and through many of the Pacific islands. Most probably it was a natural immigrant or it may have been originally introduced by the natives from other island groups of the Pacific. It was particularly noticed by the naturalists of British expeditions in the early part of last century. We have in recent years found it abundantly, in company with *Sphingolabis hawaiiensis*, in consignments of plants brought from Fiji, so that it is easily transported by these means. The latter species,

[1] Other species, *A. aporonoma*, *eteronoma*, have been described on examples, no doubt similar to those here alluded to as foreign species.

[2] Since described as *A. perkinsi* (Burr. Tr. Ent. Soc. Lond. 1910, p. 178).

S. hawaiiensis, has much the habits of *Chelisoches* and in fact is often found in company with it. Both species, in wet localities, are found nearly to sea-level.

MANTOIDEA.—The common Australian Mantid, *Orthodera prasina*, was, doubtless, introduced with orange trees from Australia, and was first noticed on the island of Kauai, about the year 1896. It is thoroughly naturalized there, but apparently does not spread rapidly and is still confined to that island. It has been noticed preying on that most beneficial ladybird *Coelophora inaequalis*, as well as various other insects.

The larger *Tenodera sinensis* is a more recent introduction from the Orient and was first noticed in some numbers in Hamakua district of Hawaii about the year 1900. It has spread to some extent over that island, but has not yet been reported from other islands of the group.

BLATTOIDEA.—The numerous introduced cockroaches are a conspicuous element in the fauna, many of them (*Periplaneta australasiae* and *americana*, *Stylopyga decorata*, *Euthyrrapha pacifica*, etc.) thriving both as domestic pests and out of doors in the open. Some, e.g. *Phyllodromia hospes* and *Loboptera extranea*, are of recent introduction, having first become noticeable towards the end of the last century, though now excessively numerous in individuals and widely spread. The females of the former are brachypterous and flightless. The *Loboptera* has been found in consignments of Fijian plants in recent years and may have been imported from that group. The common *P. germanica* remains practically a household insect, and abounds on steamers which call at Honolulu. *P. hieroglyphica* is one of the commonest of cockroaches at low and medium elevations. *Oniscosoma pallida*, taken by Mr Blackburn 30 years ago, has not since been met with. *Leucophaea surinamensis* is an exceedingly common species, the young of which are often found in great numbers under stones, and are remarkable for the appearance of the hind parts of the body, which resemble those of wood-lice, so that when the fore parts are buried in the soil they might on superficial examination be mistaken for those Isopods. *Eleutheroda dytiscoides*, another excessively numerous species, is injurious to trees, gnawing the bark from the branches of *Casuarina*, *Citrus*, etc. The young and adults often congregate in masses amongst the foliage, falling to the ground when disturbed, and scuttling off with irregular gait to conceal themselves. This species is viviparous. The pretty species of *Euthyrrapha* (*E. pacifica*) breeds in neglected cupboards amongst rubbish in houses, and also abundantly beneath dead leaves, etc., in the open, but only at low elevations. The nymphs are uniformly dull and ugly creatures, very different from the really handsome adult. A second species of this genus, or an allied form, has been more recently found in numbers on Hawaii.

Very different in habits from any of these is the endemic *Phyllodromia*, *P. obtusata*. It is a most abundant insect throughout most parts of the forests of all the islands, where it lives beneath bark of trees, in clusters of dead leaves, or in living foliage, where the leaves have a tendency to curl up and form a suitable place for concealment. It exhibits much variety in the development of the wings so that in some localities all the individuals exhibit so strong a tendency to become brachypterous, that they might almost be considered as forming a distinct species. The varieties of this species seem to be connected with special localities.

Both the endemic species and many of the foreign ones are subject to the attack of parasites. The Encyrtid *Solindenia picticornis* is bred from the capsules not only of *Phyllodromia obtusata*, but from those of other cockroaches, and parasitized oothecae are often met with. The two *Evania*, of which one has not hitherto been found in other countries, are extremely numerous on the lowlands and in the lower forest, while these are themselves destroyed by the Tetrastichine Eulophid, *Tetrastichus hagenowii*. Some of the native birds are partial to the endemic *Phyllodromia*, and the introduced mongoose sometimes devours numbers of the two large *Periplaneta*. It is unfortunate that the injurious *Eleutheroda* is, from the nature of its life-history, exempt from the attacks of Hymenopterous parasites.

Acridioidea.—The common Oriental grasshopper *Oxya velox*, confined in 1892 to Oahu and Kauai, has not yet been reported from other of the islands. It thrives in wet or moderately wet localities, in fact particularly where one finds the introduced Hilo grass (*Paspalum conjugatum*).

Atractomorpha crenaticeps appeared in Honolulu in 1900, and several years elapsed before it became really common. The original examples met with were of the brown form, but green-coloured specimens were found soon afterwards. No doubt this grasshopper was imported with plants from Australia, where we have found it commonly, or from Hong Kong, whence we have seen examples collected by Mr F. Terry. It can live in much drier localities than those frequented by *Oxya*.

Locustoidea.—This great group is represented by five genera only, and of these three are introduced forms. *Elimaca punctifera* Walk. (*appendiculata* Br.) was of early introduction, being common during the period of Mr Blackburn's collecting. It is a widely distributed Oriental species and is now thoroughly established on all the islands, but is confined to the lowlands and lower forest regions. The flattened eggs are inserted in the fronds of ferns and leaves of various plants causing a slight swelling on the epidermis. They are much parasitized by the Encyrtid Eupelmine *Anastatus koebelei*, and a minute *Trichogramma* or *Pentarthron*, the latter issuing in large numbers from a single egg. The former parasite, which is a common garden insect and found in the forest also, was not met with by Mr Blackburn and was therefore probably introduced at a later period than its host.

Holochlora venosa is no doubt a later importation from the Orient. The eggs are laid in numbers in long slits made in young shoots of the 'Avocado pear' (*Persea*) and of other trees, and arranged in regular rows in these slits. They were observed numerously as early as 1895 or perhaps earlier, but the adult insect, which is comparatively rarely met with, was not found till a much later period. Probably the eggs will prove to be much parasitized by the *Anastatus* above mentioned. Eggs of apparently the same cricket have been found in shoots of young plants brought from Hong Kong and Japan. The other imported Locustid, *Xiphidium varipenne* Swezey (= *X. fuscum* huj. op. II. 14), was a very rare and local insect in 1892, and by no means numerous in 1897, but by 1900 had become one of the most abundant of insects and spread all over the group. Probably it will prove to be an introduction from the western parts of N. America. It is to a very large extent carnivorous, devouring Homopterous insects and caterpillars. It is a delicate feeder on vegetable matter, preferring the stamens and other tender parts of flowers. The eggs are laid in a row beneath the leaf-sheath of Hilo grass, sugar-cane, *Canna*, etc., and are frequently destroyed by an Aphelinine parasite (*Paraphelinus xiphidii*) of abnormal habits, of which about a dozen examples may emerge from a single egg. For some years after its appearance no short-winged forms of the *Xiphidium* were noticed, but subsequently they became abundant. In the driest and hottest localities the short-winged forms appear to be absent or nearly so during the hottest months of the year, but appear numerously at other times.

Swezey has investigated the percentage of long-winged and short-winged forms in various localities and in various months of the year. Intermediate forms are very rare, usually about 2 per cent., where the proportion of winged and flightless examples is about 83 per cent. and 15 per cent.; whether the greater percentage consist of the long-winged or short-winged forms the percentage of intermediate forms remains much the same.

The other Locustidae are endemic and are represented by a single *Conocephaloides* (*C. remotus* Walk. = *C. hawaiiensis* huj. op.), while eight or nine species belong to the endemic genus *Banza* (*Brachymetopa* huj. op.). The former seems now to be very rare, but was probably once abundant, and has been destroyed by introduced predaceous insects. It is interesting, as being a form such as one might suppose gave rise to the more remarkable *Banza*. All the species of *Banza* (except that possibly *B. molokaiensis* and *B. mauiensis* may prove to be synonymous) are each one restricted to a single island of the group, and all those species, of which a number of examples have been collected, are dimorphic, having green and brown forms. The most remarkable case of this dimorphism is exhibited by *B. parvula* W. (*discolor* Redt.), where the whole appearance of the insect is changed owing to the coal-black face of the *discolor* var. and the pale face of the *blackburni* form. Further reference to this species will be found in Vol. II. p. 689 of this work. Briefly it may be said that in the localities, where it has been specially studied, the males of *B. parvula* are brown, black-faced insects, with green pale-faced forms occurring rarely, while the females are pale-faced green insects with black-faced brown coloured individuals occurring still more rarely than do the green males. It is interesting to notice that whereas in this species the common form of male is brown and the female green, in all other species collected in numbers both sexes are usually of the green form. In *B. nitida* var. *punae*, when brown (or at least not green) varieties occur they are, I think, always of the female sex, while in *B. parvula* the *discolor* form is nearly always of the male sex. *B. nitida*, when molested, exhibits a curious posture, threatening and protective, shown on pl. I, fig. *3b*, Vol. II., but I cannot recall having noticed this behaviour in any other species.

The species of *Banza* are entirely nocturnal in their activities, resting by day on their food-plants, and are usually very well concealed. They are not at all restricted in their habitat, for the same species may be found on very numerous trees or plants, e.g. *B. parvula* W. (=*discolor* huj. op.) is common on *Cordyline*, various ferns, *Acacia koa*, *Metrosiderus*, *Pelea*, *Straussia*, *Freycinetia*, etc. They are, however, particularly partial to *Cordyline*, *Freycinetia*, and such plants as have the leaves closely embracing the stem, thereby affording more perfect concealment, while frequently they hide amongst masses of dead leaves, when a branch of a tree has died and the leaves remain adherent to form a thick shelter. The young are also very numerous on soft ferns and frequently conceal themselves beneath the leaves of *Pelea*, which curl up around the edges and form a good hiding place. The eggs are found arranged in a row at the bases of leaves of *Cordyline* and *Freycinetia*, but they must certainly occur also on ferns, *Canna* and other plants affected by the young. The latter in *B. parvula* Walk. are more varied in colour than the adults, being green, testaceous, various shades of brown, brownish crimson, etc., but the adults produced from these are extremely uniform in comparison, being either true *discolor* form or true *blackburni*. The latter rarely produces a variety of facial coloration, which to some extent may be looked on as exhibiting partial characters of the *discolor* form. The males stridulate freely at night, but it is difficult to locate the sound. The eggs are parasitized by a species of *Eupelmus* of the Chalcids, and perhaps also by the Proctotrypids of the genus *Anteris*. Some of the species of *Banza* seem to be extremely scarce, and I suspect that a great many eggs are destroyed by parasites. Occasionally on Hawaii we have taken examples that have clearly been seized by birds, but have escaped with mutilation, It is interesting to notice that *B. nitida punae* sometimes saves its life by the loss of one or both of the hind tibiae, which are perpendicularly elevated in its attitude of defence.

GRYLLOIDEA.—Here belong the greater part of the species which form the endemic Orthopterous fauna, for of nearly forty described species only five have been accidentally introduced. These introduced forms are of very little interest.

Gryllus innotabilis is one of the commonest of insects, but is not a forest insect, being abundant on the lowlands and lower mountain elevations. We have found living specimens in consignments of growing plants sent from other countries, showing thereby that it continues to be brought here by commerce. Sometimes this cricket forms a large part of the food of the mongoose. A second species of *Gryllus* appeared in the islands in 1900 and is now at times extremely common on Oahu. *Gryllodes poeyi* is abundant in many places, and is often found beneath rocks in extremely dry situations. It also is a lowland, or at least not a forest insect. The imported mole-cricket (*Gryllotalpa africana*) is, so far as is known, still confined to the island of Oahu and has acquired an unpleasant notoriety, as being decidedly injurious. The injury done by this insect is of two kinds. Burrowing in the banks of ditches etc. it allows the water, used for irrigation purposes in cane- and rice-fields, to escape, and also, locally, seriously injures the stems of growing sugar-cane, where they lie on the ground, by driving large borings or tunnels through these. It is excessively numerous in suitable localities, and on hot dark nights, during the prevalence of southerly winds, is occasionally attracted in countless numbers to the lights of lighthouses and other less powerful lights.

The little myrmecophilous cricket is common on Oahu in the nests of various foreign ants, such as *Pleidole megacephala*, *Solenopsis geminata* and more than one species of *Prenolepis*. In migrations of some of these ants we have observed these crickets marching in line with their hosts. We have also found them in nests of ants brought in consignments of growing plants from foreign countries, when examining such consignments on the wharf in Honolulu.

The endemic Grylloids belong to two different groups, the Trigonididae, represented only by the genus *Paratrigonidium*, and an endemic family or tribe Prognathogryllidae, in no way related to the former, and containing several distinct genera. The Hawaiian species of *Paratrigonidium* are remarkable for the fact that while they severally often exhibit very great distinctness in habits, in structure and appearance they often so closely resemble one another as to be only separable with great difficulty and by very slight characters. All are true forest insects. *P. pacificum*, commonest and most ubiquitous of all the species, is chiefly terrestrial in habits. Though occasionally it ascends ferns, bananas, etc., it is mostly found actually on the ground in damp places and moves about actively by day in the deep shade. Many of the other species are strictly nocturnal, living in concealment and remaining silent by day, whereas *P. pacificum* sings the whole day through, as well as at night. *P. grande* and *P. attenuatum* are commonly found beneath bark of trees, often in mixed assemblages of young and old together. *P. saltator* and *freycinetiae* live only at the bases of the leaves of *Freycinetia*, *P. roseum*, *subroseum* and *atroferrugineum* only amongst the leaves of *Metrosiderus*; the latter, indeed, has only been found on one special variety of this tree! *P. filicum* and *viridescens* are found on ferns, each frequenting different kinds, and so not mixing together. In general, the young of the species that frequent foliage are green, however differently coloured the adults may be, whereas those that live on the ground or beneath bark of trees, have brownish or obscurely coloured young. The terrestrial *P. pacificum* is perhaps the most variable, as it is also the most numerous, and it is the most isolated structurally. In wet places the pronotum of this species is often quite white from a dense growth of fungus on that part, but this growth seems in no way to injure the insect. The arboreal species are a good deal hunted by the endemic birds, which seek them beneath the bark, as well as on the foliage. That most local of Drepanid birds, *Viridonia sagittirostris*, was almost always found to contain abundant remains of *P. freycinetiae*, which it procures from the base of the leaves of *Freycinetia*. The terrestrial *P. pacificum* is the least powerful in jumping, the saltatory powers of the arboreal species, when adult, being really prodigious for their size. It may be supposed that since these so often lose the protective colour of their nymphs, they find sufficient protection in their powers of leaping, when they have reached maturity. At any rate the sudden change from a green insect to a black and orange one, as seen in *P. atroferrugineum*, is quite remarkable. All the species, as adults, are quite wingless, the tegmina alone remaining as stridulating organs. Until the last ecdysis, wings and tegmina develop *pari passu*, but at that ecdysis the tegmina undergo much further special development, while the wing-rudiments, instead of proceeding with their development, entirely abort. It is not known whether these crickets are subject to insect parasites, but it is possible that the eggs will be found to be attacked either by the Mymarid, *Polynema*, or the Proctotrypid, *Anteris*. Not very infrequently they are found to be infested by a parasitic worm (*Gordius*) which emerges from the thorax or abdomen, and is still more frequently seen at large on fronds of ferns or on other low plants that grow in the damp shady places most affected by these little crickets.

The rest of the endemic Grylloids form the most interesting part of the orthopterous fauna. There are nearly a score of species known and they are distributed in four genera, closely related to one another, forming together a natural group. Two of the genera are represented by only a single species, and these are clearly offshoots from each one of the larger genera.

Nesogryllus, once characterized as distinct, has now long been known to us as the male of *Prognathogryllus*, originally founded on the female sex only. The species of *Prognathogryllus* have well developed tegmina in the ♂, adapted for stridulating, but both sexes are flightless, the wings being rudimentary.

In *Leptogryllus* and its offshoot *Thaumatogryllus*, the wings are absent and in some species the tegmina are so minute as to be only visible at the extreme sides of the mesonotum, while in others they cover the whole (or almost the whole) metanotum, this being the maximum of their development in the genus. *Aphonogryllus* is very imperfectly known and may be only an immature stage of some species of *Prognathogryllus*. If not, it is clearly a derivative from the latter genus.

All the species of Prognathogryllidae are entirely nocturnal and we have several times found them at night running on the trunks of trees. In the daytime some of them conceal themselves beneath bark, or in holes in decayed wood, while others inhabit the pith cavities of certain forest trees. *Prognathogryllus stridulans*, once a difficult insect to obtain in the mountains round Honolulu, has now become common, owing to the unhealthy state of many of the arborescent lobelias in this locality, as elsewhere in the islands. At the present time and in fact for the last ten years many of these trees have lost their former healthy condition, and are now either entirely dead or have many dead branches. These dead branches being hollow afford a most convenient home for *Prognathogryllus*, and rarely is a tree found in this condition which does not harbour the cricket in some or all stages. In former years it was most difficult to find a tree in the dead and dry condition suited for these crickets, and they were then more often obtained by splitting dead twigs and branches of *Pipturus*, an urticaceous tree. The males of *Prognathogryllus* stridulate only at night, after they have emerged from their retreats. The species of *Leptogryllus* have rather varied habits which, however, are not altogether constant in the case of a single species. Several (*L. elongatus, kauaiensis* e.g.) have been found numerously, hiding in dead hanging fronds of tree-ferns, or (*L. fusconotatus, elongatus, nigrolineatus*) amongst dead masses of banana leaves still adherent to the plant, beneath bark of trees (*L. simillimus*), or under moss or creeping ferns (*L. forficularis*). Another favourite hiding place for several species is at the base of the leaves of *Freycinetia*, where we have found *L. nigrolineatus, L. similis, L. fusconotatus* and other species. These crickets are sought after both by some of the Drepanid birds and also by the Meliphagine 'Oo' of Kauai. Adults and nymphal forms are usually found in company. Some of the *Leptogrylli* feign death, lying with the body somewhat crescentically curved. No parasites of those crickets are yet known, but it is quite likely that the eggs may be attacked.

In concluding this brief account of the Orthoptera a few words may be said on the endemicity in the islands of the species of the more important genera and families. In the genus *Paratrigonidium* the species are so difficult and have been so little collected in many places that not much confidence can be placed on the correctness of their distribution, as at present known. Yet, no doubt, while some are more widely distributed, others are peculiar to a single island. Thus clearly *P. saltator* of Oahu represents the *P. freycinetiae* of Hawaii, the two being very closely allied and having identical habits. Probably *P. subroseum, P. roseum*, and *P. atroferrugineum*, inhabiting Oahu, Maui and Molokai, are modified forms of one original species, for they have peculiar and similar habits. Different in appearance as these are in the adult stage, yet the nymphal stages of all are alike and the nymphs are quite unlike the mature crickets.

The endemicity of the species *Banza* (*Brachymetopa*) is no doubt great, and no one species has been found on more than one island, though it is possible that *B. molokaiensis* and *B. mauiensis* of Molokai and Maui are really one species.

In the Prognathogryllidae, *Prognathogryllus* has not yet been found on Hawaii, though it occurs on Maui, while *Thaumatogryllus* is only known from Kauai. The species of this group appear nearly all to be confined each to one island only, though *Leptogryllus nigrolineatus* has been found on Oahu and Maui and *L. apicalis* on Molokai, Maui and Oahu, and it is possible that these two described species are really only forms of one. *L. forficularis* occurs on Hawaii and in the western mountains of Maui.

Review of Thysanura and Collembola.

Very few species of these interesting insects were observed by me in the islands, and of these a single species of *Japyx*, and two each of *Lepisma* and *Machilis* only have any claim to be considered indigenous. *Campodea* was only noticed in the mountains in the vicinity of Honolulu, in the early years of my collecting, being generally found in decaying stumps or beneath rotting logs. As it was subsequently noticed in the soil, in which foreign plants were imported, there is no reason to doubt that the genus is an importation.

Japyx was only collected very rarely on Kauai, living beneath logs in company with the earwig *Anisolabis perkinsi* (= *A. pacifica*, huj. op. olim). Of the two species of *Machilis*, *M. heteropus* is an abundant species in the forests and is found beneath bark of trees, amongst dead adherent fronds of tree-ferns, and in rotten stumps. Individuals are very numerous and vary in their colour pattern. *M. perkinsi* was only found on Kauai.

Lepisma hawaiiensis is also only known from that island, where it was observed in numbers under bark of forest trees. Another *Lepisma* occurs on rocks near the sea-shore both on Oahu and Kauai. At least two species of the genus have been seen in houses in Honolulu, where one at any rate is injurious to books and other articles. Some minute Thysanura have been imported in earth containing ants' nests and are now found established in the islands with these ants. One box of plants that I examined a short time after its importation contained several ants' nests in the soil, and many Thysanura infested the nests.

It is quite uncertain whether there are any endemic Collembola in the Hawaiian group, as they are frequently imported with plants, and many have become established and very widely spread. In some forest localities we have noticed that they have become much more numerous than was formerly the case, and this may be taken as evidence in favour of their foreign origin.

The single species of the Achoreutidae, *Neanura citronella*, was the only form observed that struck me as likely to be endemic, since it was found beneath the bark of native forest trees.

Review of Myriopoda.

Of the few Chilopoda other than those which are probably or certainly importations by man, it is quite possible that *Lithobius* and *Lamyctes*, of each of which one species has been described as peculiar, may contain other allied endemic forms. A second *Lamyctes* forms a new variety of a North American species. In the Diplopoda a species of *Polyxenus* (Polyxenidae) and two of *Aporodesminus* (Cryptodesmidae), the latter genus described as new, are of quite uncertain status. They have been found amongst decaying leaves, etc., and are very probably importations. The most interesting feature of the Myriopod fauna, as at present known, is the great development of species of the genus *Dimerogonus*, elsewhere known from New Zealand, Australia and Chili. Twelve species have been distinguished by Dr Silvestri in the systematic portion of this work, and no doubt numerous others were not collected by me. They are apparently most numerous on the intermediate islands of the group, as only one species was collected by me on Kauai and none on Hawaii, though I believe I have since found specimens on the latter island.

Several new additions have been made to the Hawaiian fauna through introductions by man of late years, and we have observed these creatures in boxes of imported plants, when making inspection of these.

Review of Arachnida.

Excluding several undetermined species of quite recent introduction, the Spiders, as at present listed, are represented by 105 species of which 81 are at present only known from the islands. The endemicity of the species is, according to M. Eugène Simon, greater than that known in any other country.

Of about forty families of spiders, 32 are altogether absent from the Hawaiian fauna or are only represented by introduced or foreign forms. These latter are the Sicanidae, Pholcidae, Clubionidae and Agelaenidae, and to these should probably be added the Dysderidae.

The endemic fauna is therefore probably confined to the families Theridiidae, Argiopidae, Thomisidae, Lycosidae and Attidae, or five families only, so far as present information is concerned.

The Theridiidae are represented by five genera, none of them endemic, and one, *Teutana*, is no doubt an introduction, while I suspect that *Argyrodes* comes under the same category, one of its species being known to be foreign and the other probably is so. The single species of *Ulesanis* is also subject to the same suspicion. Excluding these we are left with a single remarkable species of *Ariamnes*, and nine unquestionably endemic species of *Theridion*, of which genus two introduced forms are present.

The Argiopidae have 10 genera, one of which, *Erigone*, contains only a single foreign species, while two *Microneta* and *Cnephalocotes* also contain a single species, each of which may prove to be foreign. *Argiope* contains a widely distributed species, *A. avara*, with a peculiar endemic variety on Kauai, and is probably a comparatively recent, natural immigrant. One species of *Tetragnatha*, *T. mandibulata*, which often abounds in the sugar-cane fields, is introduced, the other species being endemic, as are all the species of *Cyclosa*, excepting *C. oculata* and *turbinata*, both foreign, and those of *Araneus* excepting *A. nauticus*. The genera *Priperia* and *Doryonychus* are only known from the islands.

The Thomisidae are probably the most interesting and important group in the Hawaiian spiders. Three of the genera, *Proernus*, *Pagiopalus* and *Adrastidia*, form an endemic group 'Proerneae,' and the genus *Mecaphesa*, with three species known, is also endemic. Of the other three genera, *Misumena*, *Diaea* and *Synaema*, all the species are peculiar to the islands and no foreign forms have been recognized in the family, though I believe I have noticed an introduced Thomisid in recent years.

The Lycosidae are represented by three genera, one of which, *Syroloma*, is endemic, as are all the species in the others.

The Attidae are represented by a number of endemic species of *Sandalodes*, a genus pertaining to the Australian region, and several imported species of other genera, which of recent years have been added to by fresh introductions not yet determined.

The 81 species at present known only from the islands, represent 24 genera, seven of these being themselves endemic, and it is worthy of note that the endemic species contained in apodemic genera are generally highly peculiar forms, and that the endemic genera are sometimes osculant forms, e.g. *Syroloma*, which is a link between the Lycosidae and certain Clubionidae, and the 'Proernus' group of Thomisidae which forms a link between these and the Clubionidae.

How far the species are restricted in their range in the islands is at present uncertain, owing to the imperfect way in which the spiders have been collected. All those obtained by me were collected while in search of various kinds of insects. Extreme variability is exhibited by *Araneus emmae*, some species of *Misumena*, and *Diaea insulana*. The habits of the Hawaiian spiders have been very little studied, though some of the species are very numerous in individuals. Those of the genus *Theridion* are as abundant as any, spinning their webs usually low down in the vegetation (e.g. across the narrow overgrown tracks made by man or beast through fern), in the cavities of hollow trees, or in hollows in cliffs, etc. *Argiope avara* is one of the most abundant spiders, its strong webs being often conspicuous on the telephone wires, wire fences, etc., as well as amongst vegetation. Its peculiar variety is restricted to and abundant on Kauai. The endemic species of *Tetragnatha* are not usually common and are mostly obtained from branches of trees, being much sought after by the native Passerine birds. The species of *Synaema*, *Misumena* and *Pagiopalus* sometimes greatly resemble the surfaces on which they rest, viz. the lichen-covered boughs of trees, and I suspect many of them are rare, since they are by their habits most subject to the attacks of the many birds that hunt for food along the limbs of large trees. Some species of *Pagiopalus* and *Procrnus* are abundant, living at the base of leaves, where these clasp the stem closely, or amongst dead leaves on growing trees. *P. atomarius* has its eggs destroyed both by Dipterous (*Leucopis*) parasites, and by those of an Ichneumonid, and the former are themselves destroyed by the Hymenopterous Chalcid genus *Eupelmus* and by an Eulophid. The Thomisid spiders are, doubtless, extremely ancient inhabitants of the islands. As another Hymenopterous genus, *Baeus*, containing excessively minute insects, parasitic in spider-eggs, also occurs far in the native forests, some spiders are destroyed by these, though the particular hosts have not been ascertained.

Of the Lycosidae species of *Lycosa* and *Syroloma* are found beneath the bark of trees, forming tubes of silk for their retreats. Possibly certain burrows formed in the soil, the occupants of which are not known, belong to others of this group, of which some species have been found amongst dead leaves on the ground. The native species of the Attidae are often noticed hunting on the trunks or limbs of forest trees, and hide themselves and nest beneath the bark. They are an important source of food-supply for the native birds. Generally speaking it would appear that the native spiders, which live on low vegetation near the ground, or in places not much investigated by the endemic birds, are by far the most numerous in individuals.

Review of Mollusca.

The Mollusca[1], as listed in Vol. II. p. 271 *et seq.* are 476 in number. These represent 15 families, but of these, five (Philomycidae, Limacidae, Helicidae, Stenogyridae and Paludestrinidae) are unimportant, containing only species that are introduced or possibly in a few cases immigrant.

The chief interest is attached to the endemic family Achatinellidae, of which there are eight genera containing in all 311 species.

The Tornatellinidae contain 14 species of *Tornatellina* and 20 of *Auriculella.* Twenty-seven species of *Succinea* (Succineidae) have been described, and the Endodontidae are represented by 24, and the Zonitidae by 25 species. It will be seen therefore that the great majority of species of land molluscs are contained in comparatively few genera.

[1] I was only able to devote very little time to the collecting of Mollusca, and a great deal of my time was spent in localities, where these are very poorly represented. Only a very brief account of these animals is here given, since they have been so much more studied by Dr Montague Cooke, Curator of Mollusca in the Bishop Museum, and others than by myself, and many new species have been described since Mr Sykes published his paper in Vol. II. of this work.

The earliest record of the existence of slugs in the islands, that I have been able to find, is contained in the MSS. of one of the old bird collectors (Bloxam) who found 'slugs in the maw' of *Oreomyza*, shot on Oahu near Honolulu. I suspect, however, that this remark really applied to *Succinea*, which is very rarely eaten by some birds. We have never found Limacidae to be eaten by them, and the Philomycidae are certainly of quite recent introduction. The species of *Agriolimax* and *Amalia*, though some have been described as peculiar to the islands, have not the appearance (from their distribution, etc.) of being native, but are probably all introductions by man.

The Zonitidae (with seven genera) were little collected by me. *Godwinia tenella* was found at a higher elevation (9000 ft.) than any mollusc that I met with. The Endodontidae are, no doubt, numerously represented by endemic species. Some of the species are common beneath the bark of trees, and are particularly fond of *Cheirodendron*. Others occur beneath large decayed logs, or on the ground amongst decayed leaves.

Of the Helicidae the introduced *Eulota* is now widely spread and extremely common in many places. It has been observed high up the mountains on Hawaii. *Papuina barnaclei* is in the list probably on account of the specimens having been wrongly labelled as to locality.

The very minute shells of the genus *Pupa* of the Pupidae were not collected by me. The species are numerous and often found in a sub-fossil condition.

Of the Achatinellidae, the sub-genus *Achatinella*, s. str., is found only on Oahu, as also is *Bulimella*, both with numerous species or at least local forms. *Partulina* is entirely confined to the three adjacent middle islands, Maui, Molokai and Lanai, excepting that the aberrant species *A.* (*P.*) *dubia* is found on Oahu, and two or three aberrant forms, for which a distinct sub-genus (*Baldwinia*) has been proposed, are peculiar to Hawaii. *Achatinellastrum* is chiefly developed on Oahu, but also occurs on Maui, and is barely represented on Molokai. The distribution of these sub-genera is of great interest.

The beautiful shells of *Achatinella* (s.l.) have been so much studied and collected by others that it is not necessary for me here to make any lengthy remarks. Practically all the species, except on rare and probably accidental occasions, are of arboreal habits. They are found on leaves, branches or trunks of the forest trees, and individuals of a species are frequently not at all particular as to what part of the tree they frequent, nor as to the species of tree. They are often found numerously on quite dead trees, and in many places are abundant on those imported by man, especially the guava, and even on *Lantana camara*. The Myrtaceous 'Ohia' being the dominant forest tree probably contains more of these shells than any one other species of plant. It is doubtless due to the fact that the Achatinellas do not feed on the trees themselves, but on the small organisms that grow on these, that they are found on so many native and foreign plants. Great diversity of opinion exists as to the limits of the species of *Achatinella* (s.l.) and a very great deal of special breeding will probably be necessary before these limits can be fixed. It is quite certain that a very large number of the forms, that have been described as distinct, are not true species in the same sense that the majority of the species of insects are. On the whole the phenomena of variation in *Achatinella* are rather different from those exhibited by the variable forms of insects, but these are probably explicable by the very stationary habits of the Mollusca, and the difference between the two groups is rather of degree than of kind. On the other hand, I think it probable that a good many of the forms of *Achatinella*, which differ very little in appearance or structure, are absolutely distinct species. In this they are quite paralleled by many insects, for we know that in these, perfectly distinct species are sometimes separated by characters apparently much smaller than those exhibited by the extreme varieties of other species. There are numerous cases in insects where one particular variety of a very variable species has its peculiarities exactly reproduced as a constant specific character of an allied species, and I have found, as I interpret the species, exactly similar cases in *Achatinella*. But in the insects the complexity of structure allows us to be certain of the real specific distinctness of such forms, owing to structural differences that exist to confirm it, whereas the Mollusca (at least as studied from the shells) are very poorly endowed with structural characters, on which to base specific distinctions, as compared with even the most simple form of insect, and one is obliged to place more or less faith in colours and patterns of colour. In many groups of Hawaiian insects such characters, if relied on for discriminating species, would lead to hopeless confusion.

It has always been a tradition with the natives that the Achatinellas are able to sing or produce musical sounds, but I know of no confirmation of this excepting the often-quoted observation by Barnacle. Though I have lived for weeks in spots where shells were to be found on the trees immediately surrounding my camp, I have never heard any such sounds. So confirmed were the natives in their opinion, that the song of the land-shells was even put to words. An old native, whom I once had with me in the mountains of Oahu, one night called my attention to the song of a land-shell, but I actually found the creature, a species of small cricket (*Paratrigonidium*) that was making the sounds. Though the motions of the elytra in producing its song were quite visible, he utterly declined to believe that it was caused by the cricket, and persisted that it was due to a land-shell. I would suggest that what Mr Barnacle heard (making allowance for an exaggeration in description) was the stridulation of crickets beneath the bark of a tree, where they often congregate, and what he saw was a group of *Achatinella* on the bark. Several natives have informed me that the real singing shells were found especially on the 'Ki' plant (*Cordyline*), and it is certainly curious that this same plant is a favourite home of the larger green crickets of the genus *Banza*.

The bright coloration of the Achatinellas, especially of many of the banded forms, is of some interest, because it reminds one so strongly of many other animals, in which a somewhat similar strong contrast of colours is supposed to produce the effect of rendering the creatures less visible, and to be of value for protective purposes. Utterly conspicuous as the shells appear when removed from their surroundings, it is quite certain that, in spite of their bright colours, they are by no means so when resting on the leaves or branches of trees, except for occasional specimens in incongruous positions. This is quite evident from the fact that a skilled collector, with very practised eye in discovering these shells, will go over the very same trees that have just been well searched by one less accomplished and gather an astonishing number of shells from these. The remarkable fact is that though these colour patterns must have been developed on the spot, the Achatinellas would not appear to have had any need for concealment. Not even once were these shells ever found within birds, nor seen to be eaten by them, and it is astonishing that the thrush genus *Phaeornis* should not have availed itself of such an abundant source of food. It is true that the introduced rats, imported by man, feed eagerly on these Molluscs, so much so that I have gathered a hatful of empty shells of *Achatinella tesselata* at the foot of a single hollow tree, into which the rodents had carried them. But these cannot be supposed to have been a factor in determining the colour patterns. Similarly we find the terrestrial Achatinellidae of the genus *Amastra* all of dull colours and in strict harmony with their environment, these being equally neglected by birds, but devoured by imported rats. Either, therefore, from some unknown cause these land Mollusca become adapted in colour to their environment, or if these colours have been modified and controlled by causes elsewhere supposed to be efficient, this must have taken place in past ages and under different faunistic conditions. In the latter case it would be natural to consider the coloration, as having been determined by the ancestors of the existing species of the thrushes (*Phaeornis*) from the Kauai form of which, on one occasion, a minute Helicine shell was obtained by dissection. Further observations on Lanai and Molokai may yet prove that these birds do still on occasion feed on Achatinellas; but the numerous young and old birds that I examined at various seasons gave no evidence of this, and further we are perplexed by the entire absence of *Phaeornis* from Maui, unless we suppose the genus to have once existed there and now become extinct, as we know to be the case with the *Phaeornis oahuensis* on Oahu.

The other genera of Achatinellidae (i.e. the true genera as distinguished from the sub-genera of *Achatinella* itself, above mentioned) are of no less interest.

Perdicella is a comparatively small genus of prettily marked arboreal shells. *P. helena* is an abundant and variable species widely distributed on Molokai, but most of the known forms appear to be rare or very local. It is found on the leaves of Ki, Ohia and various other plants. *P. minuscula*, recorded on my specimens as being found on Molokai, must, I think, have been wrongly labelled, since I observed a species of *Perdicella* in numbers on Urticaceous plants in the Iao valley, Maui, on one occasion, and collected specimens. The genus is restricted to Molokai and Maui.

The elongate shells of the genus *Newcombia* are also restricted to these two islands and almost to Molokai. *N. cinnamomea* and allied species are found on the trunks and branches of 'Pua' trees (*Olea sandwichensis*) and are very well concealed and not very likely to be noticed unless specially sought for.

Amastra with 101 and *Leptachatina* with 76 species are the genera most widely distributed, species occurring on all the islands, though Kauai and Hawaii at either end of the group are comparatively poor in species. The species of *Amastra* (*s. s.*) are essentially terrestrial and found beneath and in cavities of rotten logs and tree-ferns, under stones, in decayed stumps, in the hollows and crevices of hard logs, and amongst decaying vegetable débris, in damp places in the forest. On Kauai (though not peculiar to it) the smaller sub-genus *Amastrella* is dominant. Here too are the two most remarkable forms of the small sub-genus *Kauaia*. The species of the sub-genus *Laminella* are of great interest from their habits, being transitional in these between *Achatinella* and *Amastra* (*s. s.*). They are largely of arboreal habits, many of them being found especially on the trunks and dead branches of trees even at a considerable height; they have the habit of smearing themselves with mucus, to which fragments of débris become attached, so that they closely resemble the surface on which they rest. Some of the species are particularly fond of Urticaceous plants and may be found on the leaves of these as well as on the trunks. *L. gravida* is sometimes found in great colonies on the fronds of soft-leaved ferns. *L. depicta* is abundant in the highest boggy forests of Molokai on the leaves of *Astelia*, above the range of other Achatinellas, and there is an allied species in similar localities on the W. Maui mountains. The small shells of the genus *Leptachatina* resemble those of *Amastra* (*s. s.*) in their habits and are often found in company with the latter. *L. arborea* is common on trees on Hawaii and of wide distribution, and even occurs on the leaves of *Myoporum* in the higher forests, above the rain-belt.

Thaanumia omphalodes is a remarkable development of *Leptachatina*, and apparently very rare. I have never met with it.

Carelia, containing the largest Hawaiian shells, is peculiar to Kauai, though it formerly existed also on Niihau. Living specimens are now scarce, but in some parts of the lower forests of Kauai many dead ones (mostly broken) were noticed, in witness of their former abundance. In some of these localities they were accompanied by many dead shells of *Kauaia* and the remains of the large weevils of the genus *Rhyncogonus*, all species still existing, but rare.

Of the Tornatellinidae the very minute shells of the genus *Tornatellina* are very numerous and occur on all the islands. They were only casually collected by me and are doubtless very numerous in species. Some species occur quite outside the forest, at low elevations.

Auriculella is very abundant on Oahu, species and individuals being numerous. They are variable not only in colour, but in the fact that some of the species have either dextral or sinistrorsal shells. Colonies of a species differ greatly in this respect, even when found at no great distance from one another. Of one species a large number of examples taken together had about 50 per cent. dextral and the same number sinistrorsal, while a near-by colony had only two per cent. of the one form. They are arboreal in their habits and, making allowance for their small size, they appeared to me much more conspicuous than the Achatinellas.

The Succineidae are found throughout the group, but are dominant on the large island of Hawaii. Twenty-seven species of *Succinea* were enumerated by Sykes, but the limits of the species appear to be even less definite than in the Achatinellas. The *Succineae* are able to thrive under the most diverse conditions of climate, though probably best developed in the true forest-belt. Some species are common in the open country at elevations of about 5000 ft., where there is little permanent moisture, and some even abound on the hottest and driest coasts. In many parts of Hawaii both the surface of the ground is covered with their empty shells and the humus filled with these, while on other of the islands, where now they are less numerous, there are great deposits, mixed with the shells of *Amastra*, *Leptachatina*, and various other living genera.

The other families of Mollusca are comparatively of little importance, but it may be mentioned that *Limnaeus pereger* is the species of fresh-water snail, in which Dr Lutz found the Redia of the Liver Fluke.

Remarks on Vermes.

Although a considerable number of species of earthworms was collected by me at various stations, often very remote from settlements, throughout the islands, I believe that all these are importations by man. On several occasions boxes of earth containing growing plants were examined, when they were landed from steamers arriving in Honolulu from China and Japan, and were found to contain great numbers of very lively and healthy earthworms. Some of these were preserved and found to be identical specifically with species that now are found far from settlements in the mountain forests. Some earthworms were specially collected in the most out-of-the-way forests in boggy places, where nearly every animal was endemic, but these proved to be only well-known foreign forms, such as *Allolobophora foetida*, etc. As plants have been imported continually into the islands both from America and the Oriental region for the course of a century, there has been ample time for foreign worms to become very widely distributed. Of late years it has been illegal to introduce plants in earth, for economic reasons, in order to keep out insect pests, so that the number of species that now occur (and doubtless some have been introduced since I made my collections) may not be so quickly added to.

The Entozoa recorded from the islands are of no interest faunistically, excepting the remarkable *Apororhynchus hemignathi*, taken from the Drepanid bird *Hemignathus procerus* on Kauai, and forming the endemic family Apororhynchidae of the Acanthocephala, and *Drepanidotaenia hemignathi*, belonging to an apodemic Cestode genus, with the same host. Another tapeworm was found in another Drepanid bird, *Loxops caeruleirostris*. It is curious that no Entozoa were noticed in birds excepting on Kauai.

FAUNA HAWAIIENSIS

VOL. I. PART I.

HYMENOPTERA ACULEATA

R. C. L. Perkins.
Prof. Aug. Forel.

Price Sixteen Shillings.
To Subscribers Eight Shillings.

The Fauna Hawaiiensis will be published in parts at irregular intervals, and will it is hoped be completed in about two years.

Contributions have been made or promised by the following, viz.

F. E. Beddard, F.R.S.	*Earthworms.*
Prof. Auguste Forel	*Formicidae.*
Dr L. O. Howard and W. H. Ashmead	*Hymenoptera Parasitica.*
G. W. Kirkaldy, F.E.S.	*Hemiptera.*
Sir John Lubbock, F.R.S.	*Thysanura* and *Collembola.*
E. Meyrick, F.Z.S.	*Macrolepidoptera.*
R. C. L. Perkins, B.A.	*Hymenoptera Aculeata, Orthoptera, Neuroptera,* and part of *Coleoptera.*
R. I. Pocock	*Myriapoda.*
D. Sharp, F.R.S.	Part of *Coleoptera.*
A. E. Shipley, M.A.	*Parasitic Worms.*
M. Eug. Simon	*Arachnida.*
E. R. Sykes, F.Z.S.	*Mollusca.*
The Lord Walsingham, F.R.S. ...	*Microlepidoptera.*
Mynheer F. M. van der Wulp ...	*Diptera.*

It is also intended to give a list of the Vertebrates, with their distribution, in the Islands.

The price of each part will vary according to its extent and the number of Plates. Subscribers to the whole work will be charged half-price for each part. The parts will be sent, as published, to each subscriber who has paid for the preceding part.

Those who wish to be subscribers, should send name and address either directly to C. J. Clay & Sons, Cambridge Warehouse, Ave Maria Lane, London, E.C., or through any bookseller. Payments for each part should also be made to Messrs C. J. Clay & Sons.

FAUNA HAWAIIENSIS

OR THE

ZOOLOGY OF THE SANDWICH (HAWAIIAN) ISLES:

Being Results of the Explorations instituted by the Joint Committee appointed by

THE ROYAL SOCIETY OF LONDON FOR PROMOTING NATURAL KNOWLEDGE

AND THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

And carried on with the assistance of those Bodies and of the Trustees of

THE BERNICE PAUAHI BISHOP MUSEUM AT HONOLULU.

EDITED BY

DAVID SHARP, M.B., M.A., F.R.S.

SECRETARY OF THE COMMITTEE.

VOLUME I. PART I.

HYMENOPTERA ACULEATA

By R. C. L. PERKINS, B.A., and Professor AUGUSTE FOREL.

Pages 1—122, *Plates I, II and Map.*

CAMBRIDGE:
AT THE UNIVERSITY PRESS.

London: C. J. CLAY AND SONS,
CAMBRIDGE UNIVERSITY PRESS WAREHOUSE,
AVE MARIA LANE.

Glasgow: 263, ARGYLE STREET.

1899

March 20th, 1899.

Cambridge:
PRINTED BY J. AND C. F. CLAY,
AT THE UNIVERSITY PRESS.

CAROLO R. BISHOP,

VIRO HONORATISSIMO,

QUI ANIMO BENEVOLENTE ET MANU PROFUSA

INSULIS HAWAIIENSIBUS

SCIENTIAE CAUSA

INSTITUTIONEM MAGNIFICAM

STABILIVIT,

OPUS HOC

INSCRIBITUR.

I. HYMENOPTERA ACULEATA[1].

§ 1. General considerations on the Aculeata.

The Aculeate Hymenoptera of the Hawaiian Islands form an important part of the fauna, nearly 200 species being at present known. Each of the large divisions of the group, excepting the Heterogyna or Ants, is represented by many endemic species. The Fossores include 34 species, divided between four sub-families; the Diploptera are well represented by 88 species in two sub-families, the Anthophila or bees by 56 species in three sub-families. The total number of species in these groups as represented in the islands, is therefore 178, but of these some are known to have been introduced in recent times from other countries, while others from various kinds of evidence we can be tolerably certain are also to be regarded as having been imported by man. To arrive at a true understanding of the peculiarities of the fauna, it is necessary to consider each family in detail.

i. In the Fossores the Sphegidae are represented by a single species of *Pelopœus*, an American insect, known to have been introduced.

The Trypoxylonidae have two species of the genus *Pison*. Although both of these were described from the islands yet one of them is also known to inhabit Fiji. It is an abundant species, generally being found about houses, and nests in the woodwork of which these are built, and is never found at any great distance from towns or settlements. The second species was found only in Honolulu some twenty years since. There is little doubt that both these species are importations, and I suspect that *P. iridipennis* after arrival has failed to establish itself.

The Mimesidae have 10 species divided equally between two genera, both of which are endemic. The two genera are certainly allied, and have probably arisen by divergence from a common ancestor, and evolved species side by side, the one not being a direct off-shoot of the other.

The Crabronidae are represented by 21 species in two genera, of which one containing 6 species is endemic, as also are all of the 21 species. It is probable however that the 15 endemic species now referred to the sub-genus *Solenius* of

[1] By R. C. L. Perkins; except Heterogyna (or Ants): this is by Prof. Aug. Forel of Zürich. Hymenoptera Parasitica has been undertaken by Dr L. O. Howard and Mr Ashmead, of Washington. There are no Hymenoptera Sessiliventres in this Fauna.

Crabro, will themselves ultimately form one or more peculiar genera, the species being closely related to one another, and also to the endemic genus *Nesocrabro*.

Putting together the results of this analysis it will be seen that the foreign element includes 3 species of two genera, representing two sub-families, two of the species and both genera being known from elsewhere, while the third species has only been taken in the city of Honolulu, a fact which alone would mark it as foreign. This gives an average of 1·5 species to the genus. The endemic species also represent two sub-families, with four genera, and 31 species. Three of the genera are endemic and all of the species, and there is an average of 7·75 species to a genus.

ii. In the true Wasps, or Diploptera, the Vespidae have two species of *Polistes*, both foreign forms, and known to have arrived since the settlement of white men on the islands. There is no doubt that both were introduced by man, and it is remarkable that a parasitic *Stylops* should have been brought with them.

The Eumenidae are represented by the single genus *Odynerus*, which is extremely rich in species, no less than 86 distinct species having occurred. All the species are endemic and form a most remarkable assemblage, exhibiting a great variety of form, although all belong to one section of the genus. Some of the species might readily be separated as distinct genera, were this course advisable, so great are their peculiarities, but as this would still leave the bulk of the species in *Odynerus*, and dissociate what appears to be really a natural series, it seems better to leave them intact, until they can be separated as a whole.

iii. In the Anthophila, or Bees, the Obtusilingues have 52 species all belonging to one genus, which, so far as is known, is endemic. These again form a remarkable series, and some of the species at first sight would hardly be recognized as belonging to the section to which they are assigned. Nevertheless when studied as a whole they are seen to be intimately related to one another, widely different as the extreme forms of the series may appear.

The Acutilingues are very poorly represented by a single *Xylocopa*, known to have been imported, and three species of *Megachile*, two of which are recent introductions, although not identified from elsewhere. They have greatly increased in numbers, and extended their range over the islands during the last few years. The third species is very possibly endemic, and is probably becoming scarcer, being now a rare insect, or at least excessively local.

Thus of the Fossores, Bees, and Wasps together, there are 170 endemic species in 7 genera, four of the latter being also endemic, with an average of over 24 species to a genus, while there are 8 introduced species representing 5 genera, giving an average of less than two species per genus.

The arrival of *Megachile* in the islands, presuming that *M. diligens* is really an endemic species, was no doubt very recent, compared with the remote periods at which the first representatives of the Fossores, Odyneri and the blunt-tongued Bees reached them. Yet both Dipterous insects and Lepidoptera must have been well established before the arrival of the predatory wasps. The *Megachile* amongst the endemic aculeates occupies a position similar to that of the solitary species of *Corvus*, and *Buteo* amongst the endemic land-birds.

iv. The Heterogyna, or Ants, form a striking contrast to the other groups of the Aculeata. Twenty species are at present known, and these are distributed amongst twelve genera. Nearly all of these are to be found most numerously in the neighbourhood of houses, although some have now spread very widely over the country, and still are spreading. The only one that has any claim to be considered endemic is a species of *Ponera*, (*P. perkinsi*), which is found only in the mountain forests under logs, and beneath the stones on the margins of the mountain streams. Two other species are not at present known from elsewhere, but of these one, (a *Prenolepis*), is known to have been introduced in boxes of earth containing plants, and the other (*Ponera kalakauae*) has been only taken near settlements, where endemic insects were absent, and it also occurs in the middle of the city of Honolulu. Of the rest, several species form races now described for the first time, but as the exact locality whence they have been imported is unknown, it is quite uncertain whether these races have been formed since the time of their importation. We have known a single box of imported plants to contain the winged sexes of three different species of ants. It is not unlikely, however, that the *Leptogenys* is a natural immigrant, and has arrived in drift-wood, for it frequently nests in the interior of tree-trunks, or beneath tightly-fitting bark. The *Ponera*, which is alluded to above as being probably endemic, may be classed with the endemic *Megachile*, as a recent form compared with the rest of the native Aculeates.

Insular endemicity. The species of *Megachile* that is probably endemic has been found on several of the islands, and the endemic *Ponera* is also distributed over the whole group. Excluding the non-endemic species (amounting to about 27), the two species just mentioned and five *Odynerus* the localities of which are unknown, there is still left a total of 164 species of endemic Aculeata.

The proportion of peculiar species to the total number found varies greatly in the case of the different islands, as shown in the following table.

	Peculiar species	Total of species	Percentage of peculiar species
Kauai	30	33	90·9
Oahu	22	33	66·6
Molokai	10	38	26·3
Maui	17	49	34·6
Lanai	2	26	7·6
Hawaii	44	54	81·4

Thus Kauai stands easily first in the peculiarity of its species, and it may further be remarked, that in the case of two of its three species which are found also on other islands, the Kauai form is by no means identical with that occurring elsewhere, but exhibits well-marked variation. Hawaii with far the largest area of any of the islands, has the greatest number of species, and ranks next to Kauai in the proportion of those peculiar to it. Maui with the second highest total of species has a much smaller proportion of peculiar ones than Oahu. In general the more remote is a given island from its neighbours the greater is the peculiarity of its fauna. The fact that Hawaii and Kauai are placed at either end of the chain of islands would tend to increase the endemic at the expense of the total number of their species, since they give and receive emigrants in one direction only. It is true that the island of Niihau lies to the west of Kauai, but it is a small and unimportant island with no considerable mountains, which can never have possessed more than a scanty fauna, and being now a pasturage for sheep was not visited by me. The Aculeata of the three adjacent islands Maui, Molokai and Lanai are much more nearly related, and a large number of species are common either to two, or to all of them. The mountains of West Maui yield some of the species which otherwise are quite peculiar to Molokai. That Maui surpasses Molokai in the number and in the peculiarity of its species is due to the much greater size and much more varied conditions of the former island. Its two widely separated mountain masses each yielding peculiar species, the great elevation of Haleakala, of which the region above the forest-belt has a special fauna, and the extensive low sandhills, dividing its eastern and western mountains, and favourable for Hymenoptera, give it a great advantage. Hawaii, as might be expected from the extreme difference in climate between the leeward and windward sides, and the very great height of its mountains, is very rich in species, and its position is favourable for a high percentage of forms peculiar to it. Oahu has the advantage of two separate mountain-ranges, each with some peculiar species, but the mountains are only of moderate height. Only two of its species are the same as those of Kauai, but it has seven identical with those of the less distant island of Molokai. Apparently not a single one of the species tabulated above extends its range over the whole group, although two or three are found on all the islands from Oahu to Hawaii.

With regard to the affinities of the endemic Hawaiian species, with those of other countries I think, in the present state of our knowledge, that there is little to be said. F. Smith expressed the opinion that they were most nearly related to the North American aculeates. Probably he based this opinion partly on the occurrence of certain well-known American species (of *Xylocopa*, *Polistes*, *Pelopœus*), and partly on the statement of de Saussure that certain of the *Odynerus* belonged to groups found in N. America. As I have mentioned above those American species that are known to occur also in the islands, have certainly been introduced by man, and therefore cannot be taken into account in deciding the affinities of the fauna. De Saussure's opinion on the Odyneri is open to suspicion, because he assigns the Hawaiian species that he examined to several of his groups of American *Odynerus*, whereas after an examination of the complete series of species described in this work, it appears that these are in reality intimately related to one another. As a matter of fact the Aculeata are a group but ill-adapted for throwing any light on the derivation of the Hawaiian fauna. *Odynerus*, the most numerous in species of this group, is a genus almost ubiquitous over the world, with vast numbers of species described, and no doubt vast numbers still uncollected. Although these display an extraordinary diversity of form and appearance, they have so far defied any satisfactory classification. The Crabronidae are almost as unsatisfactory, and have been certainly still less completely collected. Nevertheless the fact that the Hawaiian species all belong to one of the sections, in which the males are remarkable for their 12-jointed antennae, will no doubt greatly aid ultimately in deciding their affinities. The Mimesidae likewise are a widely distributed group of obscure insects, but little collected. The bees of the genus *Prosopis*, from which I have now dissociated the Hawaiian species under a new generic name, are of world-wide distribution, and are peculiarly difficult to study, and certainly great numbers of existing species are still unknown. The structure of the terminal (concealed) abdominal segments of the male is of paramount importance in this group, yet they have been entirely ignored in the majority of species described. These structures in the Hawaiian species are very distinctive, and differ greatly from such American and European *Prosopis* as I have been able to dissect, and I suspect that the affinities of *Nesoprosopis* will prove to be rather with the species of *Prosopis* found in New Zealand or Australia than with the others.

So far as one can judge from a study of the relationship of the endemic species to one another, all the Mimesidae, Crabronidae, Eumenidae, and the Bees of the genus *Nesoprosopis* could have been evolved from four species which reached the islands at some very remote period, one of the four species of course representing each group. The total absence of any representative of so many groups of the Aculeata, certainly not less fitted to pass over the great distances between the islands and other lands, and for which the country is admirably adapted, is a point greatly in favour of the view that the numerous species of each of the families represented arose from a single immigrant species, and the examination of the structures of the species themselves greatly supports this view. How rarely an immigrant can have arrived from without, can be judged from the great number of species which fail to cross the short distances between the islands themselves.

In the fragmentary condition of their Hymenopterous fauna the Hawaiian islands considerably resemble New Zealand, but in the case of the latter country it is less extreme. At the present time the Aculeata of New Zealand have been too much neglected to make any detailed comparison of value, but few species of this group having been collected there.

An important fact in connection with the Hawaiian species is their variability. This is most noticeable in the Bees, Crabronidae, and Mimesidae, a great many of the species in these groups being in a very unstable condition. The variation is not confined to differences in size, colour, &c., but affects important structures, in which it is unusual to find any noticeable variability, and to this is due the extreme difficulty of determining and describing the numerous species, the specific characters frequently having to be taken from structures which are obviously variable.

In striking contrast with the groups above mentioned are the species of *Odynerus*. Very few of the 86 species exhibit any variation of note, and this when it occurs is nearly always of an unimportant character (e.g. colour). From this one would infer that the Odyneri have now reached the maximum of species that the islands can support, in the present condition of the Lepidopterous fauna, on which, as they prey on caterpillars, they are dependent. The Bees on the other hand are not similarly restricted, for with flowers abundant at all seasons, the islands so far as one can see, are capable of supporting much greater numbers of these than of Wasps. The Fossores, which like the wasps are predatory, living on Dipterous insects, are very variable, but the total number of species of these is insignificant compared with that of the Odyneri.

The coloration of the Aculeata of the islands is very remarkable. No one examining an extensive collection of these could fail to remark the general blackness of these insects. In the majority of the endemic species the wings are dark, with blue, violet, or purple iridescence, and such species are found in each division of the group, and in every genus. For this reason many of the Fossores, Bees, and Wasps, when on the wing, greatly resemble one another and can hardly be distinguished except by differences in their flight. It is not probable that this similarity of appearance has any protective significance, for some of the species which are clear-winged and of ordinary appearance are amongst the most abundant, and birds which alone could be their enemies, neglect both alike.

In the case of the genus *Odynerus* the coloration of the species presents some remarkable features. Thus excepting one coast species, all the Kauai forms are similarly coloured, having two white or yellow abdominal bands. On all the other islands only a very few species are found with these markings, and in general the bands, when they occur, are much less conspicuous. In spite of the identity in general appearance of the Kauai insects they are often structurally very remote from one another. Thus *O. nigripennis*, a black-bodied Wasp of large size, found on all the islands from Oahu to Hawaii, is represented on Kauai by *O. radula*, with the yellow bands characteristic of the species inhabiting that island. Again *O. heterochromus*, a black species found on Hawaii and very remote structurally from *O. nigripennis*, is also represented on Kauai by a species with two yellow bands, and so on in other instances. On Molokai a very large number of species have red markings. Two species found in company on Oahu, *O. oahuensis*, and *O. pseudochromus*, are excessively alike in superficial appearance, and unlike any other species, being both remarkable for their hyaline wings, and peculiar red markings; yet structurally they are not allied to one another. It might be supposed that the local peculiarities of coloration have a protective value, but as I have pointed out in the Proceedings of the Cambridge Philosophical Society all the evidence is opposed to this view.

Another noteworthy point about the endemic aculeates is the general feebleness of their sculpture. Of the large number of species of *Odynerus* there are certainly a good many in which the puncturation is strong and even coarse, but in many it is very feeble or nearly entirely effaced. The bees are nearly all remarkable for their fine and shallow puncturation, as also are the Mimesidae, while in the Crabronidae the general tendency is to effacement of the sculpture.

The literature relating to the Hawaiian aculeata is as follows:—

Fabricius, *Ent. Syst.* II. p. 269.

De Saussure, *Etud. fam. Vesp.* III. *Mon. Masar. et Suppl.* p. 289.

Smith, *Cat. Hym. Ins.* I. p. 23. *Id. op. cit.* IV. p. 421.

Holmgren, Eugenies Resa, *Zool.* VI. p. 441.

Smith, *J. Linn. Soc.* XIV. pp. 674—685.

Blackburn and Kirby, *Ent. Mo. Mag.* XVII. pp. 85—89.

Cameron, *Trans. Ent. Soc.* 1881, p. 562.

Blackburn and Cameron, *P. Manchester Soc.* XXV. (Session 1885—86), pp. 134—176.

Dalla Torre, *Wien. Ent. Zeitg.* VIII. (1889), p. 124 *et seq.* (also *Cat. Hym. Ins. passim*).

Perkins, *Proc. Phil. Soc. Cambridge*, Vol. IX. Part VII. (1897), p. 378.

Altken, *Ent. Nachr.* XXIV. (1898), p. 340.

§ 2. Systematic account of the Hymenoptera Aculeata.

FOSSORES.

The Fossorial Hymenoptera of the islands are represented by only six genera, and of these probably two have no place in the autochthonous fauna. All the genera belong to that section, which comprises the insects with short prothoraces, and they represent four distinct sub-families. The truly endemic species however belong entirely to the Mimesidae and Crabronidae, and all prey on Dipterous insects; the members of the former family, so far as I have observed, provisioning their cells invariably with species of Tipulidae, while those of the latter prey not only on these, but also on other Flies. In some cases at any rate a species of Crabro will take Flies of very different species, by no means confining its attention to the capture of one particular kind. Some of the species of this genus are very abundant, and may sometimes be seen in great numbers around a dead animal, to which they are attracted by the abundance of their prey.

Sphegidae.

(1) *Pelopœus caementarius.*

Sphex caementaria, Drury, Exot. Ins. I. p. 105.

Pelopœus caementarius, Blackburn and Cameron, P. Manch. Soc. xxv. p. 173.

Hab. Very abundant all over the islands, but not extending to great altitudes on the mountains. An introduced species, common in North America. Preys on Spiders.

Mimesidae.

The Hawaiian Mimesidae form two distinct genera, the females of which are very unlike one another, but the males in some cases can only be distinguished by slight characters. In the genus *Nesomimesa* the males of the several species are excessively difficult to separate, but the females afford better characters. All the species are remarkable for the feebleness of their thoracic sculpture. The genal spines of the ♀, although subject to excessive variation in most species, nevertheless afford useful characters, as also does the condition of the surface of the anterior area of the propodeum, and the colour of the spines of the anterior tarsi. In the genus *Deinomimesa* also the females afford the better characters. These are chiefly found in the form of the clypeus, but the carinated pedicel of the basal abdominal segment, although variable in structure in some species, is of considerable assistance in the determination of the species. The Hawaiian species of the family, so far as they have been observed, prey entirely on Tipulidae. They usually burrow in the ground, but have occasionally been seen entering burrows in dead trees.

Nesomimesa, gen. nov.

Forma gracili, elongata, capite a fronte transverso. Palpi maxillares longi, pilosi, articulo 2° et 3° fortioribus, 4° elongato lateribus parallelis, 5° forma praecedentis sed longiore, 6° perlongo et gracillimo. Palpi labiales articulo apicali perlongo. Antennae longae, ♂ evidenter, ♀ subfortiter clavatae. Tibiae posticae spinis brevibus armatae. Tarsorum articulus apicalis ♀ in basali parte spinis utrinque fortioribus armatus, ad apicem spinis longis, gracillimis. Abdominis segmenti primi pars petiolata parte apicali evidenter longior. Armatura genitalis ♂ duabus appendicibus angustis et elongatis apice instructa. Caput ♀ utrinque spinis genalibus armatum; area pygidialis triangularis, punctata, setis decumbentibus vestita.

Allied to *Mimesa*, having a similar neuration. Both sexes have long clavate antennae, but the thickening of the apical joints is more pronounced in the ♀. The third joint is much longer than the fourth, which is about equal in length to the scape. In the ♀ the cheeks beneath are prolonged into a large spine, which differs in form in the different species, and is very variable in examples of the same species. This sex is also remarkable in having the last joint of the tarsi armed on either side towards the base with somewhat stout spines; at the apex there are longer and very fine ones. The pygidial area is flat, punctured, and carinated at the sides, and bears appressed setae of a spinose character, which give it an appearance of being strigose. The stipites of the ♂ genital armature are rounded at the apex, and there bent inwards, and fringed with hairs; a little before the apex they each give off a long thin process, set with short hairs, and the one crossing the other. The spine of the apical ventral segment is long, strong, and slightly curved upwards.

(1) *Nesomimesa kauaiensis*, sp. nov.

Nigra, elongata, antennarum articulis apicalibus subtus, tarsisque ♂ anterioribus plus minusve pallidis; clypei ♂ margine antico plus minusve distincte tridentato; genis ♀ post oculos in spinam validam productis. Alae subinfuscatae. ♂♀. Long. 8·5—13 mm. (Plate I. figs. 1—1 *c*.)

Male black, the front tarsi testaceous, the apical joints of the antennae pale beneath. Clypeus with dense silvery pilosity, its apical margin more or less distinctly tridentate. Antennae long, subclavate, extending back as far as the apex of the basal segment of the abdomen, the third joint considerably longer than the scape. The front and vertex of the head are dull, without evident puncturation. Mesothorax less dull than the head, with very feeble scattered punctures, the surface with an exceedingly fine reticulation of raised lines; wings more or less infuscate. Anterior area of the propodeum smooth except for the minute surface sculpture (which is like that of the mesothorax), not defined by a raised line, but rendered distinct by the absence of the pubescence which covers the rest of the propodeum. Spines of the front tarsi pale. Abdomen impunctate or nearly so, the petiole long and narrow, much longer than the apical part of the segment, usually rounded above at least on its basal portion, but somewhat compressed in some examples.

Female generally larger and more robust than the ♂, but with similar sculpture. The apical joints of the antennae more or less fulvous beneath. Head large and wide, mandibles very long, the anterior margin of the clypeus angulately produced in the middle, the cheeks behind the eyes produced into a strong spine, which continues their outline, the antennae more strongly clavate than those of the ♂, their third joint very long and slender. Anterior tarsi with much longer pale spines, and the posterior and intermediate tibiae and tarsi with the spines much more strongly developed. Apical dorsal segment of the abdomen carinated at the sides, punctured, clothed with appressed hairs, which give it a strigose appearance.

HAB. Kauai (2500—4000 ft.); common, burrowing in the hard ground in bare spots in the forest.

(2) *Nesomimesa sciopteryx*, sp. nov.

Praecedentis forma; alis totis piceis, clypeo subtiliter griseo-pubescente distinctissima. ♀. Long. 11 mm.

Female very like that of the preceding in form. The wings are entirely of a pitchy colour, and have a slight violet iridescence. The face below the antennae is clothed with a fine greyish pubescence, instead of the appressed silvery pilosity of all the other Hawaiian species. The posterior calcaria are testaceous, and the petiole of the abdomen is stouter, and its dorsal surface more strongly curved.

HAB. Halemanu, Kauai (4000 ft.); very rare, 1 ♀ only taken.

(3) *Nesomimesa antennata.*

Mimesa antennata, Smith, Cat. Hym. Ins. IV. p. 431.

N. kauaiensi simillima; ♀ spina genali ad basim contorta, ♂ clypei margine apicali haud evidenter tridentato distinguendus. ♂ tarsis anticis testaceis, ♀ propodei area antica haud nitida, tarsorum spinis anticorum pallidis. ♂ ♀. 7—13 mm.

Very like *N. kauaiensis*, but generally the ♀ is less robust and has the head smaller. It may be at once distinguished by the form of the spine on the cheek, which, instead of continuing the outline of the face behind the eyes, is raised at the base, and somewhat twisted, so that, in a lateral view of the head, the spine presents a sharp edge. The apical margin of the clypeus is produced into a small median tooth. In well-developed examples the facial spines are very long, more or less pointed at the apex, and their margins sinuate. The mesothorax is somewhat shining, the scutellum distinctly so, the anterior area of the propodeum very dull, as compared with the scutellum. The wings are sometimes more or less clouded, often almost entirely clear. The spines of the anterior tarsi are pale.

The ♂ differs from that of *N. kauaiensis* only in the shape of the anterior margin of the clypeus, which is not evidently tridentate, although somewhat produced in the middle.

HAB. Mountains of Oahu (2000 ft. and upwards).

(4) *Nesomimesa nitida*, sp. nov.

Praecedenti simillima; ♀ area propodei antica nitida, ♂ tarsis anterioribus infuscatis distinguendus. ♂ ♀. Long. 7—12 mm. (Plate I. figs. 1 and 1 *a*.)

Extremely like the preceding species. The ♀ is distinguished readily by the form of the spine on the cheeks, when this is well developed. In such examples, when the head is viewed from in front the spines are widely, and more or less obliquely, truncate at the apex, and the margin is there reflexed. When the spines become reduced in size this distinction is lost, in which case the smoother anterior area of the propodeum, which is but little less shining than the scutellum, will separate the two species. The wings are entirely, but not very deeply, infuscate, and often have a blue iridescence. The spines of the tarsi are for the most part pale.

The ♂, which varies greatly in size, can only be distinguished, so far as I can see, by the darker anterior tarsi.

Var. *a*. Abdomen red. (♀.)

Hab. Molokai, Lanai, and Maui (2000—5000 ft.). It is possible that the examples from Maui, of which I have seen only one or two, may be distinct.

(5) *Nesomimesa hawaiiensis*, sp. nov.

Duabus spp. praecedentibus simillima; ♀ spinis genalibus plerumque brevioribus, acutis; area propodei antica opaca; tarsorum spinis piceis vel nigricantibus distinguenda. Tarsi ♂ anteriores obscurati; area propodei antica haud nitida. ♂ ♀. Long. 6·5—13 mm.

Female similar to those of the two preceding in general appearance. The spines on the cheeks apparently do not ever attain to so great a length as in well developed examples of those species. In front view they are acute at the apex, and divergent, but sometimes are so short as to be invisible in this aspect. The thorax is altogether duller than in the allied species, the anterior area of the propodeum being quite dull. The spines of the tarsi are dark.

The ♂ is extremely similar to that of *N. nitida*, but the duller surface of the anterior area of the propodeum will usually distinguish them.

Hab. Mountains of Hawaii (4000 ft.); widely distributed.

Deinomimesa, gen. nov.

Genus *Nesomimesae* cognatum. Genae ♀ inermes; clypeus fortiter elevatus, labro patente; antennae fortiter clavatae. Abdominis segmenti primi (♂ ♀) pars petiolata distinctissime carinata.

The species for which this genus is formed are evidently allied to those of the genus *Nesomimesa*, but the females present peculiar and striking characters, and the males are not difficult to distinguish. In the former sex the antennae are more strongly clavate, the cheeks are not armed with spines, the clypeus is greatly raised, and exposes the whole or a great part of the large labrum, and the posterior tibiae and tarsi are much more densely spinose. In both sexes the petiole of the abdomen is very distinctly carinated, and in some of the species is extraordinarily developed. The males may further be known by the greater development of the raised lines on the propodeum.

(1) *Deinomimesa ferox*, sp. nov.

Nigra, sparsim minus distincte punctata, antennarum articulis apicalibus subtus fulvescentibus, alis subinfuscatis. Mesopleurae subopacae. Abdominis segmentum primum fortiter et acute carinatum. Clypeus ♀ in medio margine fortiter emarginato. ♂ ♀. Long. 8—13·5 mm. (Plate I. figs. 3—3 *b*.)

Male black, the face below the antennae, and the base of the mandibles, with appressed silvery pubescence; above, with longer pale hairs, the surface dull, without definite puncturation. Antennae long, clavate. Mesothorax with some very feeble indefinite punctures, scutellum somewhat shining, the mesopleurae dull. Wings more or less clouded, the marginal cell and apical portion more deeply. Propodeum rugose. Abdomen with the petiole flattened above at the sides, and with a sharp median carina from base to apex, its surface dull, finely rugulose. The rest of the abdomen shining, and impunctate.

Female more robust than the ♂, the clypeus strongly raised, and exposing the large rugose labrum. The apex of the clypeus is deeply emarginate in the middle, the mandibles are strongly curved. Antennae with the club more definite than that of the ♂, the apical joints very wide in proportion to their length, the third joint slender, and very long. Mesothorax with feeble indistinct punctures, the mesopleurae dull. Propodeum more or less rugose, but the raised lines are not numerous, the posterior concavity is large and deep and bounded by strongly raised lines. Intermediate and posterior tibiae with dark spines, the posterior metatarsi spinose above, beneath, and outwardly. Abdomen with the petiole very wide, dull and rugulose, raised in the middle into a great carina, which (at least towards the base), is not very sharp above as is that of the ♂, and is gradually raised from the base to the apex. Behind the petiole the segment is generally longitudinally grooved, but not in all examples, and its surface is very smooth, shining and impunctate. Pygidial area as in the genus *Nesomimesa*.

Hab. Mountains of Kauai (3000—4000 ft.).

(2) *Deinomimesa cognata*, sp. nov.

Praecedenti cognata; ♂ mesopleuris laevioribus et nitidis; ♀ clypeo (desuper aspecto) levissime lateque emarginato, distincta. ♂ ♀. Long. 9—12 mm. (Plate I. figs. 4—4 *b*.)

Female of more slender form than the preceding species. The anterior margin of the clypeus, as seen from above, is not deeply and dentately emarginate, but only very lightly and widely so. The petiole of the abdomen is differently formed, its dorsal surface being very narrow, with the margins parallel and straight, but the sides beneath are extended outwardly, and so are visible from above, and form the outline of the segment in a dorsal view. The carina itself is much less elevated and almost of even height throughout its length. On the ventral side the basal segment lies in two planes, the basal part being sub-horizontal, the apical inclined. The latter occupies more than half the segment. In the preceding species the formation of the basal ventral segment is on a similar plan, but the inclined posterior portion is relatively much smaller.

The male is much more difficult to distinguish, but the petiole is narrower in proportion to its length, and the mesopleurae are smoother and more shining.

HAB. Kauai (4000 ft.). Local and rare.

(3) *Deinomimesa hawaiiensis*, sp. nov.

Praecedentibus minor, abdominis segmenti primi parte pedicellata carinam mediam linearem ferente: ♀ clypei margine antico (desuper viso) fortissime rotundato, haud emarginato. ♂ ♀. Long. 7—8 mm. (Plate I. fig. 5.)

Allied to the preceding species, but not very closely. It is of considerably smaller size. The petiole is very slender in both sexes and the carina appears as a median raised line.

In the ♂ the anterior area of the propodeum is traversed longitudinally by numerous distinct but very fine raised lines. In the ♀ the clypeus is raised, its front margin seen from above is very strongly rounded, and not at all emarginate; the basal segment of the abdomen beneath is simple, not formed as in *D. cognata*.

HAB. Kona and Kau districts on Hawaii (4000 ft.); several examples taken, but only one ♀.

(4) *Deinomimesa punae*, sp. nov.

Praecedenti simillima; ♀ scutello minus opaco, clypeo magis abrupte elevato, margine desuper viso antice subangulato, distinguenda. ♀. Long. 9 mm.

This species resembles *D. hawaiiensis* in general appearance, and in the form of the petiole of the abdomen. The clypeus is very abruptly raised, and in a front view of the face nearly the whole surface of the labrum is exposed, which for the most part can only be seen in an apical view in the preceding species. Seen from above the apical margin of the clypeus is angulate in the middle. The scutellum has a median depression and the surface is in that region somewhat shining.

HAB. Olaa, Hawaii (2000 ft.); 1 ♀ taken in June, 1895.

(5) *Deinomimesa haleakalae*, sp. nov.

D. konae simillima; ♂ parte abdominis segmenti primi pedicellata supra compressa, et carinata. ♂. Long. 8—9 mm.

Male very similar to that of *D. hawaiiensis*, but a larger insect. It may be easily distinguished by the form of the petiole of the abdomen which is compressed above from the sides into a median carina, whereas in *D. hawaiiensis* this part is flattened above and has a raised line down the middle. The front tarsi outwardly are more or less infuscate.

HAB. Haleakala, Maui (4000 ft.); a few ♂♂ taken in May, 1896.

This species in the ♂ approaches most nearly to the genus *Nesomimesa*, but the distinct carination of the abdominal petiole, and the much more rugose propodeum, assign to it the allied one; and the ♀ will no doubt be found to have the characteristic form of clypeus, when that sex is discovered.

TRYPOXYLONIDAE.

(1) *Pison iridipennis.*

Pison iridipennis, Smith, J. Linn. Soc. XIV. p. 676.

HAB. Honolulu (Blackburn). I have never met with this species. I suspect it of being an introduced species, which apparently has failed to establish itself.

(2) *Pison hospes.*

Pison hospes, Smith, *l. c.* p. 676.

HAB. Abundant all over the islands, especially about houses. No doubt an introduced species. I have received examples from Fiji.

Crabronidae.

Crabro (*Solenius*).

The fifteen species which I have referred to the sub-genus *Solenius* of *Crabro* fall naturally into three groups, which are readily distinguished by structural characters in the ♂, but the females present no special distinctions in the two groups, in which this sex is known. In the first group the sixth joint of the ♂ antennae is produced into a rather long prominent tooth at its apex; in the second it is emarginate, but only slightly produced. The third group contains only two species (one of which I have never seen), the ♂ only being known, remarkable for the form of the ventral abdominal segments. Possibly, however, Blackburn's *C. abnormis* does not really belong to this group, and *C. curtipes* is the only representative. Although I have referred these Hawaiian species to the sub-genus *Solenius*, I have no doubt they will ultimately form one or more peculiar genera. The pygidial area of the ♀ is flatter, less elongate and excavated than in typical *Solenius*, and there are other differences. The punctuation is very similar in most of the species, and is generally feeble and shallow, often subobsolete. The chief characters for specific distinction are found in the antennae of the ♂, differences in sculpture of the thorax, the colour of the pilosity of the clypeus, of the antennae, mandibles, &c., and in the form and sculpture of the second ventral segment of the abdomen.

(1) *Crabro* (*Solenius*) *monticola*, sp. nov.

Niger, clypeo argenteo-piloso, abdomine flavo-notato, alis subhyalinis. ♂ antennarum articulo sexto fortiter dentato. ♂ ♀. Long. 5·5—9·5 mm. (Plate I. figs. 6 and 6 *a*.)

Male black, second segment of the abdomen with a yellowish-white fascia at the base, sometimes reduced to a round spot on either side. Third segment black, or with a spot on each side; fourth sometimes with an entire fascia, more often an interrupted one, sometimes only a spot on each side, or entirely black; fifth with an entire fascia, often very broad, as also the sixth segment. Head and mandibles black, the clypeus with appressed silvery pubescence; antennae with the fifth joint of the flagellum emarginate beneath and strongly produced at the apex into a projecting tooth; vertex dull, the surface rugulose with very shallow and obscure subobsolete puncturation. Mesothorax dull, clothed with thin pale pubescence, the surface densely rugulose, with very feebly impressed punctures. Propodeum longitudinally rugose in front, the surface dull, clothed with pale hairs. Abdomen subovate shining, with very fine indistinct punctures; second ventral segment very finely, but not closely punctured, except on a round area on either side, where the punctures are fine and dense; third segment beneath slightly, fourth more distinctly, fifth and sixth strongly depressed.

Female with the mandibles in front (except at the apex), the front of the scape of the antennae, a fascia at the base of the second segment of the abdomen (often widely interrupted, or reduced to two round lateral spots), sometimes a spot on either side of the third and fourth segments, and a complete band on the fifth, yellowish-white. In one example a small round spot on either side of the second segment is the only abdominal marking. Sculpture very much as in the ♂, the puncturation of the thorax generally rather more distinct, the mesothorax posteriorly and the front of the scutellum more or less shining, but variable in this respect. Abdomen generally rather stouter than that of the ♂; sixth dorsal segment distinctly punctured, the surface shining; second segment beneath hardly shining, finely and remotely punctured, except on the circular lateral pubescent spots, where the puncturation is fine and very dense; the following segments with an apical row of punctures, otherwise impunctate; apical ventral segment subcarinated, and closely punctured on either side. Posterior tibiae with pale spines. Wings subhyaline in both sexes.

HAB. Mountains of Kauai (3000—4000 ft.). Mountains of Oahu, both ranges.

OBS. The Oahuan examples agree with those from Kauai in structure, but show a stronger tendency to a decrease in size or obliteration of the pale markings on the abdomen.

(2) *Crabro* (*Solenius*) *molokaiensis*, sp. nov.

Niger, ♂ antennarum articulo sexto fortiter dentato, ♀ articulo primo antice cum mandibulis flavis. Clypeus argenteo-pilosus. Abdomen nigrum. ♂♀. Long. 6·5—10 mm.

Allied to the preceding species, the ♂ entirely black, except the front tibiae which are testaceous inwardly, the ♀ with the mandibles (except at the apex) and the scape of the antennae in front yellowish-white. Clypeus with silvery pubescence in both sexes. Male with the fifth joint of the flagellum of the antennae strongly produced at the apex into a prominent tooth. Vertex of head in the mesothorax with obscure subobsolete puncturation, the scutellum, more or less, slightly shining. Abdomen beneath dull, the second segment with fine punctures, the lateral pubescent spots very finely and densely punctured; fourth and following segments deeply concave. Female with the mesothorax much more distinctly punctured than that of the ♂, dull in front but more or less polished behind, where the puncturation is less shallow and more distinct; scutellum entirely shining, not depressed in the middle, distinctly punctured: propodeum dull, rugulose, with very short longitudinal rugosity in front. Abdomen with the pygidial area of the sixth segment shining, distinctly punctured, its sides raised; second segment beneath hardly shining, remotely and finely punctured, except on the lateral pubescent spots, where there is the usual very fine and close puncturation.

Wings in ♂ with distinct blue iridescence, which is generally less evident, and sometimes wanting in those of the ♀.

HAB. Mountains of Molokai (3000 ft.), 1893. Haleakala, Maui (5000 ft.), 1 ♂.

(3) *Crabro* (*Solenius*) *mauiensis*.

Crabro mauiensis, Blackburn and Cameron, P. Manch. Soc. Vol. XXV. p. 165 (1885—86).

Resembles *C. affinis* in the golden pubescence on the clypeus, but the more deeply canaliculated front of the head, and the coarser facets of the eyes, would (the ♂ being unknown) rather associate it with *C. monticola*. That species, however, has the clypeus clothed with bright silvery pubescence.

HAB. "A single female occurred on Maui, near Wailuku, flying over flowers." (Blackburn.)

(4) *Crabro* (*Solenius*) *haleakalae*, sp. nov.

Niger, clypeo aureo-piloso, mandibulis nigris, antennarum articulo primo antice albido. Mesonotum postice cum parte scutelli anteriore laeve ac nitidum. Abdominis segmentum 2 ventrale nitidissimum, et circa medium parcissime punctatum. ♀. Long. 10 mm.

Female greatly resembling *C. molokaiensis* in general appearance but with the mandibles entirely black and the clypeus clothed with golden pubescence. Posterior part of the mesothorax and the scutellum in front with the surface smooth shining and distinctly punctured, the latter dull posteriorly. Abdomen with the second ventral segment highly polished all over the middle portion, with a very few scattered punctures, at the sides with the usual circular pubescent spots and dense fine puncturation. Spines of posterior tibiae dark, and stronger than those of the preceding species. Wings almost clear.

HAB. A single ♀ taken on Haleakala, Maui, at an elevation of 4000 ft. May, 1896.

(5) *Crabro* (*Solenius*) *hawaiiensis*, sp. nov.

Niger, clypeo argenteo-piloso, alis infuscatis, subcaeruleo-iridescentibus, mandibulis articuloque antennarum primo nigris. ♂ antennarum articulo sexto fortiter dentato. ♂♀. Long. 6—10 mm.

Both sexes entirely black, the wings infuscate, and in the ♂ with a distinct blue iridescence; clypeus with silvery pubescence.

Male with a prominent tooth at the apex of the fifth joint of the flagellum of the antennae, as in the preceding species.

Head and thorax entirely dull with very shallow subobsolete puncturation, hardly visible in some examples. Female with the thoracic puncturation, and especially that of the scutellum, much more distinct than that of the ♂, the mesothorax posteriorly and the scutellum more or less shining, but variable in this respect. Second ventral segment of the abdomen with the surface exceedingly finely rugulose, not highly polished, in the ♂ with very fine indefinite punctures about the middle, in the ♀ with remote but larger ones.

Hab. Hawaii, various localities; common at an elevation of about 4000 feet.

Obs. This species is variable in size and sculpture; the ♀ is at once distinguished from *C. molokaiensis* by the black scape and mandibles, the ♂ is very similar but the scutellum and the mesothorax posteriorly appear to be always quite dull.

(6) *Crabro* (*Solenius*) *tumidoventris*, sp. nov.

Praecedenti simillimus, sed abdominis segmento secundo ventrali fortiter convexo, mandibulis ♀ ex majore parte pallidis distinguendus. ♂ antennarum articulo sexto fortiter dentato. ♂ ♀. Long. 7—9·5 mm. (Plate I. fig. 7.)

Very like the preceding in general appearance; ♂ with the scape and mandibles black; ♀ with the scape of the antennae black, the mandibles white; ♂ rarely with some indication of a pale spot on the mandibles.

Fifth joint of the flagellum of the antennae produced into a prominent tooth at the apex in the ♂, the front of the head and the mesothorax with very shallow rugose puncturation; propodeum more or less longitudinally rugose in front, and in this sex usually with a few fine transverse raised lines above the insertion of the abdomen. Second ventral segment of the abdomen very convex longitudinally and transversely, the surface shining, finely and rather remotely punctured about the middle, more closely towards the sides, and very densely and minutely on the circular pubescent spots; fourth and fifth segments generally strongly depressed, sometimes the fourth less strongly, and the fifth and sixth more so. Basal joint of the front tarsi unusually wide, about twice as long as its greatest width.

Female very like the ♂, except for the white mandibles and sexual differences. Mesothorax and scutellum quite dull; second ventral segment shaped as in the ♂, finely and distinctly punctured in the middle, densely and very finely on the pubescent spots. Apical dorsal segment very narrow between the lateral carinae, more or less largely and rugosely punctured. Wings of the ♂, and often of the ♀ with blue iridescence.

HAB. Both mountain ranges of Oahu; Molokai, Lanai and Maui. Examples (at least of the ♀) from Oahu appear to have a less distinct blue iridescence on the wings than those from Molokai &c.

Crabro (*Solenius*) *tumidoventris* var. *leucognathus*.

Forma praecedentis, ♂ mandibulis, ♀ mandibulis, antennarumque articulo basali antice albis; abdomine nonnunquam albo-notato.

This form on Hawaii corresponds to *C. tumidoventris* on the four islands named above. A single ♀ from Oahu appears to hardly differ from the Hawaii form, and a few ♂♂ from Maui are somewhat intermediate. For the most part, (and I have examined many of both forms) the two are readily distinguished. The variation of the var. *leucognathus* appears to be very different to that of the typical form, since in the ♂ the abdomen not infrequently is spotted at the sides of the 5th and 6th abdominal segments, (or on one of these), and rarely also on the 2nd segment; one ♀ has small lateral whitish spots on this segment, and on the 4th, and an interrupted band on the 5th.

HAB. Island of Hawaii; Kona (2000—3000 ft.); Kilauea (4000 ft.); Olaa (2000 ft.).

(7) *Crabro* (*Solenius*) *affinis*.

Crabro affinis, Smith, J. Linn. Soc. XIV. p. 677; Blackburn and Cameron, P. Manch. Soc. Vol. XXV. (1885—86), p. 165.

Niger, alis subhyalinis, abdomine plus minusve flavo-notato. ♂ clypeo argenteo-piloso, antennarum articulo sexto haud fortiter dentato; ♀ clypeo aureo-piloso, antennarum articulo basali antice, mandibulisque plus minusve flavescentibus. ♂♀. Long. 6·5—11 mm. (Plate I. fig. 8.)

Male with the scape of the antennae and mandibles dark, in the ♀ they are more or less yellowish. Abdomen in the ♂, with the 2nd, 4th, and 5th, rarely the 3rd, with pale markings. Sometimes these markings form entire bands, or they may be reduced to lateral spots. Female with a band on the 2nd, 4th, and 5th segments, often similarly reduced in size, those on the 2nd and 5th sometimes wanting, so that probably an entirely black variety may be found.

Male, clypeus clothed with silvery hairs; antennae with the 5th joint of the flagellum emarginate beneath, very little produced at the apex, beyond the base of the following joint, so that it does not form a conspicuous prominent tooth, as in all the preceding species. Front of the head with rough, shallow puncturation, smoother on the vertex behind the ocelli. Mesothorax and scutellum dull, with shallow obsolete puncturation, but the punctures are more distinct in some examples than in others. Mesopectus at the sides posteriorly with the carinae strongly elevated, forming a stout prominent tooth when viewed from in front. Abdomen above somewhat shining; second ventral segment shining, remotely and distinctly punctured about the middle; 4th and following segments flattened and depressed.

Female with the clypeus clothed with golden hairs. Puncturation much as in the ♂, but generally more definite, the mesothorax posteriorly and the front of the scutellum being often more or less polished and shining. Abdomen with the second segment above hardly shining, very finely, but rather distinctly punctured; beneath it is very highly polished, and has only a few scattered punctures on the middle portion, and a very dense and minute puncturation on the lateral pubescent spots. Apical dorsal segment nearly flat above, its margins very slightly raised, the surface more or less rough, and punctured. Posterior tibiae with the spines well developed, and dark. Wings subhyaline in both sexes.

HAB. Kauai, abundant from the coast to 4000 ft.

(8) *Crabro* (*Solenius*) *notostictus*, sp. nov.

Niger, clypeo argenteo-piloso, pronoto cum postscutello abdominisque segmento secundo flavo-notato, antennarum articulo sexto haud fortiter dentato. ♂. Long. 6·5—8·5 mm.

Var. Abdominis segmento secundo nigro.

Male allied to the preceding, having the antennae similarly formed. Mandibles and scape of the antennae black, clypeus with silvery pubescence. Prothorax with yellow spots, the postscutellum with a transverse one. The second segment of the abdomen has a yellow band, sometimes broken into two spots or altogether absent; the other segments always black. The front of the head has the puncturation nearly obsolete and shows, in certain positions, distinct but very fine strigosity. The mesothorax is dull and rugulose with hardly visible puncturation. The second ventral segment of the abdomen with the surface evidently but very finely rugulose, and a few scattered, rather large, subobsolete punctures about the middle, the sides with the usual dense and minute puncturation. The following segments with their surface quite dull.

Female unknown.

HAB. Mountains of Oahu, taken on several occasions.

(9) *Crabro* (*Solenius*) *mandibularis*, Smith.

Crabro mandibularis, Smith, Proc. Linn. Soc. XIV. p. 677 ♀.
Crabro denticornis, Smith, (♂) *l.c.* p. 678.
Crabro mandibularis, Blackburn and Cameron, P. Manch. Soc. Vol. XXV. (1885—86), p. 167.

Niger, ♂ clypeo argenteo-piloso, postscutello (nonnunquam etiam pronoto, tuberculis, abdominisque segmento secundo) flavo-notato, antennarum articulo sexto haud fortiter dentato; ♀ antennarum articulo basali, mandibulis plus minusve, pronoto, tuberculis, et postscutello flavo-notatis, clypeo aureo-piloso. ♂♀. Long. 7—10 mm.

Black, the ♀ with the front of the scape of the antennae, the mandibles more or less, a spot on each side of the prothorax, its tubercles, and a transverse spot on the postscutellum, yellowish; the ♂ generally has only the spot on the postscutellum, rarely also the tubercles and prothorax and the sides of the second abdominal segment with yellow markings.

Male with the sixth joint of the antennae formed much as in the preceding species, being but little produced at the apex. Clypeus clothed with silvery hairs, the head above the antennae generally distinctly strigose and feebly punctured, but in small examples the strigosity is sometimes obsolete, or nearly so. In the region of the ocelli the puncturation is generally distinct though shallow; the surface of the mesothorax is smoother than that of the preceding species, the puncturation very feeble. Surface of the abdomen very finely rugulose, and with hardly visible puncturation; second ventral segment with the surface finely rugulose, and not highly polished, with sparse scattered punctures.

Female, clypeus with golden hairs; head in front strigose and punctured, smoother on the vertex posteriorly, with shallow but distinct punctures between and at the sides of the ocelli. Mesothorax with shallow punctures, the surface somewhat smooth, especially posteriorly, where it is even slightly shining (or at least less dull than in front), as also the scutellum. Abdomen with grey pubescence; second segment not shining, rugulose, without distinct puncturation, beneath the surface is distinctly rugulose and very sparsely punctured, except at the sides. Apical dorsal segment flat, its margins but little raised, dull towards the apex, punctured, and more or less smooth between the punctures towards the base. Wings quite infuscate in the ♂, less so in the ♀.

Hab. Molokai, Lanai, and Maui, on the coast and in the mountains at an elevation of 3000 ft.

This species is very closely allied to *C. notostictus* ♂, but the puncturation of the vertex of the head is more distinct, and the mesothorax smoother. The normal coloration of the two is different, the Oahuan species having, in typical examples, the prothorax and also the second abdominal segment spotted, whereas in *C. mandibularis* individuals so marked are found only as very unusual varieties.

(10) *Crabro* (*Solenius*) *fulvicrus*, sp. nov.

Niger, clypeo aureo-piloso, tibiis anticis femoribusque (plus minusve) intus fulvo-testaceis; ♂ articulo antennarum sexto haud fortiter dentato, abdominis segmento 4° et 5° (vel uno ex his) nonnunquam albo-notatis; ♀ mandibulis et antennarum articulo primo plus minusve albo-flavescentibus. ♂♀. Long. 8—12 mm.

Black, ♂ with the anterior femora almost entirely, and the anterior tibiae inwardly, bright fulvotestaceous; ♀ with the colour of the femora often much obscured. Abdomen black in the ♀, in the ♂ sometimes with a whitish spot on the sides of the 4th and 5th segments, or on the 5th only, and sometimes an entire band on the latter. Scape of the antennae in front and the basal part of the mandibles yellowish in the ♀. Clypeus of both sexes with golden pubescence, of a very pale tint in the ♂.

Scape of the antennae in the ♂ often more or less fulvous, the fifth joint of the flagellum very little produced at the apex, hardly dentate. Head in front very shallowly, rugosely punctured, mesothorax with feebly impressed puncturation. Abdomen with the second segment above rather shining, very finely, but evidently punctured; beneath, with the surface shining, and finely and remotely punctured about the middle.

Female with the head above the antennae finely and densely punctured, the mesothorax posteriorly more or less smooth, and generally (as also part of the scutellum) somewhat shining. On this smoother portion there is a shallow but evident puncturation. Abdomen with the second segment above as in the ♂; beneath about the middle very smooth and shining with sparse and rather large puncturation. Sixth dorsal segment flat, its margins slightly raised, the surface rough and punctured.

Wings of ♂ infuscate generally with more or less blue iridescence, the wings of the ♀ clearer.

Hab. Kona, Hawaii (4000 ft.); Olaa (2000 ft.).

(11) *Crabro* (*Solenius*) *polynesialis*.

Crabro polynesialis, Cameron, Trans. Ent. Soc. 1881, p. 562. Blackburn and Cameron, P. Manch. Soc. xxv. (1885—86), p. 168.

Praecedenti simillimus, niger, clypeo aureo-piloso, ♂ antennarum articulo sexto haud fortiter dentato, ♀ mandibulis, antennarumque articulo basali, plus minusve flavescentibus. Tibiis anticis femoribusque haud fulvo-testaceis, mesonoto (♀) postice haud distincte punctato, abdominisque segmento 2 ventrali ruguloso, minus nitido distinguendus. ♂♀. Long. 7—12 mm.

Very like the preceding in most respects, but the ♂, so far as I know, never has the abdomen spotted with white.

Both sexes may easily be distinguished by their dark front femora and tibiae, and the ♀ by the mesothorax being duller posteriorly, and without the distinct punctuation of the preceding on that part. The second ventral segment also is evidently less highly polished, its surface being evidently rugulose.

HAB. Mountains of Hawaii (4000 ft.). Common generally.

(12) *Crabro* (*Solenius*) *unicolor*.

Crabro unicolor, Smith, Cat. Hym. Ins. IV. p. 421. Blackburn and Cameron, P. Manch. Soc. Vol. XXV. p. 169 (1885—86).

Niger, alis infuscatis, et caeruleo-iridescentibus, mandibulis utriusque sexus cum articulo basali antennarum nigris, clypeo argenteo-piloso. ♂ articulo antennarum sexto haud fortiter dentato. ♂♀. Long. 7·5—13 mm.

Black, the wings infuscate and with a steely-blue iridescence. Mandibles and scape of the antennae black in both sexes, and the clypeus clothed with silvery pubescence. Calcaria of the posterior tibiae bright testaceous in the ♀.

Male with the sixth joint of the antennae very little produced at its apex beyond the base of the following joint; head in front with shallow, close and rugose puncturation. Mesothorax with very shallow punctures, the surface somewhat smooth about the middle. Propodeum longitudinally rugose in front. Abdomen with the second ventral segment finely and not very closely punctured about the middle on its basal portion, towards the hind margin densely and very minutely; third segment somewhat depressed except at the base; the following segments deeply depressed.

Female like the ♂ in most respects. The mesothorax posteriorly towards the middle is smoother and more or less shining. Propodeum very finely longitudinally rugose to the brow, at its anterior margin the rugosity is not so fine. Abdomen with the second segment very finely but densely and quite distinctly punctured; beneath very highly polished on its middle portion and sparsely and clearly punctured, very finely and densely on the lateral pubescent spots. Apical dorsal segment nearly flat, its margins slightly raised, the surface somewhat rough, and punctured.

HAB. Oahu, Molokai, Lanai and Maui; abundant on the coast and in the mountains to an elevation of 4000 ft. or more. Preys on Tachinids &c.

(13) *Crabro* (*Solenius*) *atripennis*, sp. nov.

Praecedenti forma facieque simillimus, mandibulis antennarumque articulo basali albescentibus facile distinguendus. ♂♀. Long. 8—13 mm.

Very like the preceding in form and sculpture, but in neither sex is the mesothorax posteriorly as smooth, nor is the surface in that region at all shining. The calcaria of the posterior tibiae are darker, and the front of the scape of the antennae and the mandibles are yellowish-white. Wings deeply infuscate and with a steely iridescence, and the sixth joint of the antennae but little produced at the apex, as in the preceding species.

HAB. Common generally on Hawaii from the lowlands to an elevation of 5000 ft. Preys on Tachinids, and also sometimes enters houses and carries off the introduced house-fly.

(14) *Crabro* (*Solenius*) *curtipes*, sp. nov.

Niger, alis infuscatis, antennarum articulo sexto haud fortiter dentato, clypeo argenteo- vel pallidissime aureo-piloso, abdominis segmento primo pubescentia longa nigraque vestito, segmento 2 ventrali subdepresso, dense punctato, segmentis caeteris peropacis et depressis. ♂. Long. 6—11 mm. (Plate I. fig. 9.)

Male black, the wings infuscate and with little iridescence. Head, thorax, and basal segment of the abdomen with erect dark pubescence, clypeus with silvery, or faintly golden, appressed hairs. Antennae with the fifth joint of the flagellum of the antennae emarginate beneath, but little produced at its apex. Head very densely rugosely punctured in front, less so on the vertex posteriorly. Mesothorax dull, rugosely punctured. Propodeum with excessively short wrinkles at its anterior margin, behind these with shallow subobsolete punctures. Abdomen with the basal segment extremely finely punctured, and clothed with long dark hairs; second and following finely closely and evenly punctured. Beneath, the second segment is flattened, closely punctured, and inclined, the third flattened or slightly depressed and inclined in the opposite direction to the second, so that the two meet at an obtuse angle. The surface of the third and of all the following (which are depressed) is very dull, having an appearance of granulation or dense puncturation, which is due to a dense meshwork of raised lines. Posterior tarsi very short in proportion to the tibiae, all the joints taken together hardly being equal to the latter in length.

HAB. Kona, Hawaii, about 4000 ft.; 1 ♂, Aug. 1892. Olaa (2000 ft.), and Kilauea (4000 ft.), several ♂♂ in 1896. I do not know the ♀ of this remarkable species, which might well form a distinct genus, should the other sex present any striking characters.

(15) *Crabro* (*Solenius*) *abnormis*.

Crabro abnormis, Blackburn and Cameron, P. Manch. Soc. Vol. xxv. p. 168 (1885–86).

This remarkable species is perhaps allied to *S. curtipes*, and probably might well be separated generically from the other Hawaiian species. It differs from all these in the abruptly incrassate fifth joint of the antennae, and the extremely long tooth on the sixth. Although I repeatedly searched for it in the locality specified, I never had the good fortune to meet with a specimen.

HAB. Konahuanui, Oahu (2500 ft.); 1 ♂ taken by Mr Blackburn. The ♀ which he suggests as belonging to this ♂ is more probably that of *C. tumidoventris*.

Nesocrabro, gen. nov.

Caput inter oculos latum, haud fortiter concavum. Fossae antennales ab oculorum marginibus spatio distincto disjunctae. Clypeus pilis suberectis (haud metallicis) vestitus. Antennarum ♂ articulus sextus subtus emarginatus, apice haud fortiter producto. Alarum cellula submarginalis longe post medium, apicem versus, venam recurrentem accipiens. Area propodei antica haud definita. Tibiae posticae spinosae, tarsorum articulus ultimus fortissimus. Area pygidialis ♀ elongata, angustissima, utrinque fimbriata.

The species for which this genus is proposed appear to be allied to those which are provisionally placed under the subgenus *Solenius* of *Crabro*. The face is unusually wide between the eyes, and but little concave. The antennal fossae are separated from the latter by a considerable space. The facets of the eyes in front are comparatively fine. The clypeus is clothed with a fine suberect pubescence, instead of the appressed silvery or golden hairs, so usual in Crabronidae. In the ♂ the 6th joint of the antennae is emarginate beneath, and slightly produced at the apex. The ocelli form a triangle, much widest at the base. In the wings the recurrent nervure is received far beyond the middle (towards the apex) of the submarginal cell. The anterior area of the propodeum is not defined. The front tarsi are simple, the posterior tibiae spinose, the claw joint of the tarsi very large. Pygidial area of the ♀ elongate and very narrow, fringed on each side with long hairs, its sides carinated.

(1) *Nesocrabro compactus*, sp. nov.

Niger, thorace et abdomine albido-notatis, alis subhyalinis, abdominis segmentis apicalibus haud rufo-pubescentibus. ♂ antennarum articulo sexto subtus emarginato, apice vix dentato. ♂♀. Long. 7·5—9 mm. (Plate I. fig. 10.)

Male black, the prothorax often with two spots on the hind-margin and a small one on the tubercles, a transverse spot on the postscutellum, a band usually broad and entire on the second abdominal segment, a spot or line on each side of the third or fourth, a wide band on the fifth, and one on the sixth, yellowish-white. Basal segment also sometimes with an apical spot.

Female with a line on the scape of the antennae, the basal part of the mandibles, two spots or a band on the prothorax, a transverse spot on the scutellum and postscutellum, a broad band on the second abdominal segment, a narrower one on the third and fourth, sometimes also a line on the posterior and intermediate tibiae beneath, a spot at the apex of the front tibiae, on each of the posterior coxae and trochanters, and a small one on each side of the second ventral segment of the abdomen, yellowish-white.

These markings are very variable.

Male, with the fifth joint of the flagellum of the antennae emarginate beneath, hardly produced at the apex. Head in front, and the mesothorax with dense and rugose but shallow puncturation. Propodeum more or less longitudinally rugose. Abdomen with the second segment extremely finely punctured; beneath, somewhat strongly convex, and finely punctured; fourth ventral segment flattened or slightly depressed, fifth and sixth depressed. Apical dorsal segments with inconspicuous pale pubescence, and the puncturation almost obsolete.

Female very like the ♂ in general sculpture, but the puncturation usually slightly weaker. Posterior tibiae roughened, the asperities with short pale spines. Apical dorsal segment elongate and very narrow, coarsely punctured at the base, and sparsely fringed with pale hairs. Second ventral segment sparsely punctured about the middle, very minutely and densely on the lateral pubescent spots. Wings subhyaline in both sexes.

Nesocrabro compactus var., *lanaiensis* var. n.

Male with a large spot on the scutellum, as well as the postscutellum, yellowish-white; the band on the second abdominal segment narrow and interrupted. In the ♀ this band is less wide than in the typical specimens. The surface of the head on the vertex is smoother and less dull in both sexes, and the surface of the mesothorax posteriorly in the ♀ somewhat smooth and shining between the punctures.

Hab. Mountains of Kauai (2500—4000 ft.), preying upon Diptera of moderate size, and forming burrows in trodden pathways and bare banks in the forest. Var. lanaiensis. Mountains of Lanai (above 2000 ft.). Not common. In the ♂ the tendency seems to be to an increase of thoracic, and decrease of abdominal marking, as compared with the Kauai series.

(2) *Nesocrabro bidecoratus*, sp. nov.

Niger, mandibulis, antennarum articulo basali, thorace, et tibiis flavo-notatis, abdomine fasciis flavis ornato; segmento quinto cupreo, dense punctato, pubescentia aureo-rufa vestito, sexto pilis ejusdem coloris fimbriato. ♀. Long. 10 mm.

Female black, with the basal half of the mandibles, a line on the scape of the antennae, an interrupted band on the prothorax, a transverse spot on the scutellum and postscutellum, a spot at the base of all the tibiae beneath, and a band on each of the first four segments of the abdomen, yellow. Fifth segment of a somewhat metallic copper colour, densely punctured, and clothed with dark golden-red pubescence, the elongate sixth segment fringed with similar hairs, its surface somewhat smooth, and strongly, but not densely, punctured. Head in front with shallow dense punctures, the vertex with dark pubescence. Mesothorax clothed with black pubescence, the surface dull, the puncturation shallow, and by no means coarse. Propodeum with grey pubescence, and with short longitudinal rugosity at the extreme front; behind this dull, the surface roughened. Abdomen with the second segment densely and finely punctured; beneath, about the middle, it is impunctate; towards the sides distinctly punctured, very densely and minutely on the lateral pubescent spots. This segment and the basal have a pale yellow spot on their ventral surface. Posterior tibiae with pale reddish spines, the calcaria bright fulvo-testaceous. Wings subhyaline, somewhat clouded towards the base.

Hab. A single ♀ taken at Kilauea, Hawaii, in September 1895. In spite of its extremely distinct appearance I suspect it may prove to be a variety of the following species.

(3) *Nesocrabro rubrocaudatus*.

Crabro rubrocaudatus, Blackburn and Cameron, P. Manch. Soc. Vol. XXV. p. 172 (1885–86).

Niger, abdomine nigro, segmentis apicalibus rufo-pubescentibus; ♂ thorace opaco, haud flavo-notato, alis infuscatis, caeruleo-iridescentibus, ♀ thorace (antice saltem) opaco, alis subhyalinis minus fortiter infuscatis. ♂♀. Long. 7·5—10 mm. (Plate I. fig. 11 and 11*a*.)

Male black, the wings deeply infuscate and with bright blue iridescence; the 5th, 6th, and 7th abdominal segments densely clothed with red pubescence. Female with the 5th segment so clothed and the sixth with a fringe of the same colour, the prothorax and postscutellum sometimes spotted with yellow, wings much less dark than those of the ♂, subhyaline or lightly infuscate, sometimes with more or less blue iridescence.

Antennae of the ♂ with the 6th joint but little produced at the apex; front of the head dull and subobsoletely punctured, clothed with dark hairs and in some examples distinctly longitudinally strigose amongst the punctures. Mesothorax dull, with dense surface rugulosity and shallow puncturation. Propodeum more or less rugose, more strongly in some examples than others. Second segment of the abdomen very finely punctured above; beneath very finely and densely punctured towards the apex, less so towards the base, the punctures distinct; the apical ventral segments lightly depressed, and fringed with golden-red hairs.

Female, except for the differences given above, very like the ♂. The mesothorax posteriorly is slightly smoother, and less dull, the longitudinal rugosity of the propodeum extremely short. The second ventral segment of the abdomen, about the middle, has at the most a few somewhat large and very shallow punctures, its surface is excessively finely rugulose, and not very shining; the apical dorsal segment is very narrow, and coarsely punctured. There is a rather conspicuous pale pubescence on the segments preceding the two apical ones.

Hab. Various localities on Hawaii (from 2000—4000 ft.). Not very abundant.

(4) *Nesocrabro daemonius*, sp. nov.

Niger, alis infuscatis, haud evidenter caeruleo-iridescentibus, mesonoto minus opaco, plus minusve flavo-maculato, abdominis segmentis apicalibus pubescentia rufa ornatis, segmento ♀ 2 ventrali nitido, laevissimo, in medio fere impunctato; fronte pilis nigricantibus, tibiis anticis pubescentia brevi et obscura vestitis. ♂♀. Long. 8—12 mm.

Black, the wings infuscate (less so in the ♀), but with little or no blue iridescence. The prothorax and postscutellum usually both bear yellow spots in the ♂, but they are variable in this respect; in the ♀ these spots are much larger, and the scutellum also has a large transverse one, as well as the first and second ventral segments of the abdomen. The latter may also be present in the ♂, as also spots on the scutellum. The apical segments are clothed with golden-red hairs as in *N. rubrocaudatus*, and the preceding segments in the ♀ with dense and fine whitish pubescence. From that species the much less dull surface of the whole insect will readily separate the present one, as well as the much more distinct puncturation of the front of the head and the mesothorax; the surface of the latter in the ♀ being altogether smooth and shining between the punctures. In the ♂ the second ventral segment of the abdomen is densely and distinctly punctured all over, in the ♀ its surface about the middle is nearly or quite impunctate, smooth, and shining.

The fifth dorsal segment of the ♀ is aeneous and very densely punctured. Front of the head, and the front tibiae with dark pubescence, very short on the latter.

Hab. Mountains of Molokai (3000—4000 ft.). Iao Valley, Maui.

(5) *Nesocrabro adspectans.*

Crabro adspectans, Blackburn and Cameron, P. Manch. Soc. Vol. XXV. p. 171 (1885–86).

I have not seen this species. It is very closely allied to *N. daemonius*, but differs from that species in having the front of the head clothed with golden-red pubescence, and long hairs of the same colour on the front tibiae.

HAB. Haleakala, Maui (5000 ft.). A pair were taken by Mr Blackburn 15 or 20 years ago.

(6) *Nesocrabro stygius.*

Crabro stygius, Kirby, Ent. Mo. Mag. XVII. p. 88. Blackburn and Cameron, P. Manch. Soc. Vol. XXV. p. 170 (1885–86).

Niger, alis subhyalinis, vix infuscatis, pronoto ♀ nonnunquam flavo-notato, segmentis ♂ apicalibus pubescentia pallida ♀ pubescentia rufa vestitis. ♂. Long. 8 mm.

This species is very closely allied to *N. rubrocaudatus*, but the ♂ may be at once distinguished by the subhyaline and very faintly infuscated wings, the pubescence of the apical abdominal segments, which is of a pale golden colour, the more distinctly subrugosely punctate front of the head, and the shining surface of its vertex.

From *N. daemonius*, the dull and less smooth surface of the mesothorax and scutellum, the unspotted thorax and the clearer wings, from *N. adspectans*, the obscurely coloured pubescence of the head and front legs (as well as the characters which distinguish it from *N. daemonius*), will readily separate it.

I have not seen an example of the ♀.

HAB. Mountains of Oahu (Blackburn). Head of Pauoa Valley (March 1895).

DIPLOPTERA.

VESPIDAE.

(1) *Polistes aurifer.*

Polistes aurifer, Saussure, Mon. Guêpes Soc. p. 78.

HAB. Very abundant all over the islands. Stylopized examples taken on Lanai and Hawaii.

(2) *Polistes hebraeus.*

Polistes hebraeus, Fab. Mant. Ins. I. p. 292.
Polistes macaensis, Fab. Syst. Piez. p. 272.

HAB. Oahu and Kauai; on the plains. Olaa, Hawaii (2000 ft.).

EUMENIDAE.

This group is represented by a large number of species of the genus *Odynerus*, no less than 86 species being known to me. These *Odynerus* are of great interest and importance, and exhibit a great diversity of structure in the various species, and will no doubt, at some future period, themselves form several distinct genera. In striking contrast to other Hawaiian aculeates (the Mimesidae, Crabronidae, and *Nesoprosopis*) the specific structural characters, (and even the coloration if a few species are excepted), are remarkably constant. These characters are chiefly found in the general sculpture of the insect, the form of the clypeus, the shape of the dorsum of the second segment of the abdomen, but especially in the structure of the ventral plate of this segment. This ventral segment normally consists of three distinct parts, (1) a smaller basal portion, (2) a transverse sulcature traversed by longitudinal costae, (3) a larger apical portion, with a more or less distinct depression. Each of these parts may furnish useful characters; the basal portion in some species is large and tumid, the costae may be of great length, moderate, or entirely obsolete, the apical portion may be flattened to the level of the costae or greatly and perpendicularly raised above them, and the depression may be wide, narrow, deep, or obsolete. The habits of the species are of interest. All those that I have been able to observe prey on the larvae of moths (Pyralidae, Noctuidae, and Micro-Lepidoptera), so that the number of caterpillars destroyed must be immense, especially as the wasps appear to be on the wing at all seasons of the year. Their cells are sometimes formed in the ground, often in the wood of dead trees, and in the case of many species in the cavities of the porous blocks of lava. A few build solitary cells of mud, attached to leaves of trees, but these I have only found when the leaf has been rolled up by a spider, the nest of the latter and the cell of the wasp being fixed side by side. That very abundant species *O. nigripennis* is very partial to houses, forming its cells in cavities in woodwork, or unused locks. It also frequently occupies the empty cells of *Pelopœus*.

All the Hawaiian species of the genus belong to the section formerly known as *Leionotus*. As in the Fossores and Anthophila I have described afresh all the species previously known, whenever I have had specimens for examination, the large number of new forms rendering the old descriptions of little use. The measurements of *Odynerus* are taken from the front of the vertex of the head to the apical margin of the first abdominal segment, instead of to the apical extremity of the abdomen.

(1) *Odynerus venator*, sp. nov.

Niger, minus robustus, fronte inter antennas flavo-maculata, segmenti primi abdominis margine apicali saepe pallido, alis infuscatis et violaceo-iridescentibus. Clypeus leviter dentato-emarginatus. Mesonotum minus fortiter densissime rugoso-punctatum. Segmentum abdominis secundum a basi fortiter elevatum. Long. (a fronte usque ad apicem segmenti 2^i abdominis) ♂ 7—9, ♀ 9—12 mm.

Black with a small yellow spot between and just behind the points of insertion of the antennae, and another behind each eye near the vertex; the apical margin of the basal segment of the abdomen often narrowly yellow, or testaceous. Clypeus with the apex dentately emarginate very feebly in the ♀, more strongly so in the ♂; head above the antennae with shallow rugose puncturation. Mesothorax dull, somewhat finely and very closely rugosely punctured; wings infuscate, with violet iridescence. Propodeum quite dull, impunctate or nearly so. Abdomen with the basal segment shallowly punctured, rather more deeply and closely in the ♂ than the ♀; second much raised from the base, the highest point being about one-third the length of the whole segment from the basal margin, finely, evenly and remotely punctured to near the apical margin, where the puncturation becomes close, coarse and shallow, as on the following segments; beneath, with its depression triangular and somewhat deep, meeting the apices of the costae; at the sides the segment is raised from their apices to about the height of its basal portion.

Hab. Hawaii, Kona and Kau districts (2000 to 4000 ft.).

(2) *Odynerus erro*, sp. nov.

Praecedenti forma et puncturatione simillimus, sed thorace toto nitido distinctissimus. ♀. Long. 11 mm. (Plate I. fig. 12.)

Black and shining with a median spot just behind the antennae, another behind each eye near the base, and the sides of the apical margin of the basal segment of the abdomen, pale. Clypeus with the apex dentately emarginate; head above the antennae dull with shallow, close and rugose puncturation. Mesothorax shining; densely, subrugosely punctured, the puncturation consisting of scattered larger punctures (which are not coarse), and a system of smaller punctures which in this species is extremely strongly developed, so that the difference between the two systems is much less than usual; wings with violet iridescence. Propodeum with feeble subobsolete punctures, sometimes hardly visible. Second segment of the abdomen strongly raised from the base, the depression beneath not so deep as in the preceding species. ♀.

HAB. Oahu, Waianae Mts. and coast. Haleakala, Maui (5000 ft.)? A single ♀ only taken in each case. I think it probable that the latter locality is erroneous.

(3) *Odynerus naiadum*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus, fronte, mesopleuris, postscutello (maris etiam pronoto) rubro-notatis; segmento primo abdominis postice rubro-marginato. ♂ clypeus fortiter, ♀ minus fortiter sed distincte dentato-emarginatus. Mesonotum haud nitidum, subtilius subrugoso-punctatum. Abdominis segmentum secundum elevatum; subtus, depressione sat lata et alta. ♂♀. Long. 9—10 mm.

Black, the wings infuscate and with blue iridescence. The front of the head behind the antennae, the mesopleurae, the postscutellum, and in the ♂ the prothorax also, have red markings. The apical margin of the basal segment of the abdomen has a red band, dilated at the sides. Clypeus deeply dentately-emarginate in the ♂, less deeply, but distinctly so in the ♀. Head closely and rugosely punctured. Mesothorax dull, with two systems of puncturation. The larger punctures are not coarse and on the posterior half of the thorax somewhat irregular, the minute interstitial punctures are unusually strong, especially in the ♀, and both kinds have a tendency to run into each other, giving the thorax a subrugose appearance. Propodeum with subobsolete shallow puncturation, the posterior concavity subrugose. Basal segment of the abdomen shallowly punctured; second strongly raised from the base in the ♂, somewhat less so in the ♀; beneath, with the depression distinct and deep.

HAB. Molokai mountains (3000 ft.); local and scarce. Iao Valley, Maui, 1 ♀.

(4) *Odynerus erythrognathus*, sp. nov.

Niger, minus robustus, mandibulis rufis, alis caeruleo-iridescentibus. Clypeus ad apicem depressus, vix emarginatus. Mesonotum opacum sparsim subtilissime punctatum, puncturatione fere obsoleta. Abdominis segmentum secundum elevatum, subtus depressione lata. ♂♀. Long. 8—10 mm.

Black, the mandibles red, the wings with blue iridescence. Apex of clypeus (as in nearly all the Hawaiian species) depressed from the sides, giving it a dentate appearance, very slightly emarginate, or truncate; head above the antennae very dull, with fine feebly impressed punctures. Mesothorax dull, very finely and obscurely punctured, scutellum impunctate or nearly so; wings infuscate with blue iridescence. Propodeum dull, impunctate, or with faint traces of almost obsolete punctures. Basal segment of the abdomen dull, with shallow punctures, second raised from the base but not very strongly, more so in the ♂ than the ♀; beneath, with the depression wide and deep; the segment at the sides, raised up abruptly and rather strongly from the apices of the costae, prominent on either side of the depression at its base.

HAB. Kilauea, Hawaii (4000 ft.).

(5) *Odynerus melanognathus*, sp. nov.

Niger, minus robustus, alis caeruleo-iridescentibus. Clypeus ♂ fortiter, ♀ evidenter dentato-emarginatus. Mesonotum opacum, sparsim subtiliter punctatum. Propodeum puncturatione levissime impressa, fere obsoleta. Abdominis segmentum secundum subtus depressione lata. ♂ ♀. Long. 9—11 mm.

In general appearance very like the preceding, but easily known by the following characters. Mandibles dark, apex of clypeus of ♂ deeply, of ♀ distinctly, though less strongly, dentately-emarginate. Mesothorax rather more distinctly punctured, the propodeum in front with very shallow but evident punctures. Second abdominal segment beneath rather less prominent on either side of the depression in front.

HAB. Kona, Hawaii (1500 ft. and above). Rare. 1♂ 2♀ taken.

(6) *Odynerus cyphotes*, sp. nov.

Niger, alis caeruleo-iridescentibus. Mesonotum opacum subtilissime sparsim punctatum. Segmentum abdominis secundum fortiter subitoque tuberculato-elevatum, subtus depressione minus lata. ♂ ♀. Long. 8—10 mm. (Plate I. fig. 16.)

Mandibles dark, apex of clypeus hardly emarginate, head above the antennae dull, evenly and very shallowly punctured. Mesothorax dull, with fine sparse punctures, sometimes nearly obsolete, and an exceedingly minute and close puncturation between these. Wings infuscate, with blue iridescence. Propodeum sometimes with a very feeble indication of shallow punctures. Abdomen with the basal segment slightly depressed along its apical margin, and shallowly punctured; second very strongly and abruptly raised from the base into a tuberculate form above; beneath, with the depression rather narrow, the segment at the sides rising abruptly from the costae to a height as great or rather greater than that of its basal portion.

HAB. Kona and Kau districts of Hawaii (4000 ft.).

(7) *Odynerus vulcanus.*

Odynerus vulcanus, Blackburn, P. Manch. Soc. Vol. xxv. (1885–86), p. 152.

Niger, alis caeruleo-iridescentibus. Clypeus leviter emarginatus vel subtruncatus. Mesonotum cum scutello peropacum, subaequaliter distincte punctatum. Propodeum (plerumque reticulatim) rugosum. Abdominis segmentum secundum (praecipue maris) fortiter elevatum. ♂ ♀. Long. 8—10 mm.

Black, the mandibles dark, the wings with blue iridescence. Clypeus with the apex depressed and slightly emarginate, sometimes truncate. Front of the head densely and distinctly punctured. Mesothorax with the surface quite dull, somewhat closely and evenly punctured, posteriorly about the middle the punctures generally are sparser. Scutellum dull and distinctly punctured. Propodeum with rugose sculpture generally reticulate. Abdomen with the basal segment closely and largely punctured; second segment strongly and abruptly raised from the base, especially in the ♂; beneath, the depression wide but not deep, so that even at the sides the segment rises not at all strongly from the level of the apices of the costae.

Hab. Hawaii, widely distributed and not rare.

(8) *Odynerus hiloensis*, sp. nov.

Praecedenti simillimus, sed mesonoto minus opaco, densius ac grossius punctato, abdominis segmento secundo subtus minus late depresso distinguendus. ♂ ♀. Long. 7½—10½ mm.

Extremely like *O. vulcanus* but may be known at once by the almost or quite shining surface of the thorax between the punctures. The mesothoracic puncturation is also closer and coarser, and the depression of the second ventral segment evidently less wide.

Hab. Hawaii, not rare on the windward side of the island, in the forests above Hilo (2000 ft.) and at Olaa.

(9) *Odynerus konanus*, sp. nov.

Niger, alis caeruleo-iridescentibus. Clypeus levissime emarginatus vel truncatus. Mesonotum nitidum, distincte aequaliter punctatum. Propodeum rugosum. Segmentum abdominis secundum elevatum, subtus depressione lata, late costarum apices antice attingente. ♂ ♀. Long. 9—11 mm.

Black, the wings with blue iridescence. Clypeus depressed at the apex, slightly emarginate or truncate. Head in front densely and distinctly punctured, shining between the punctures. Thorax shining, mesothorax strongly and evenly punctured, rather more largely and closely in the ♂ than the ♀. Propodeum rugose in front. Abdomen with the second segment raised from the base (more strongly in the ♂); beneath, the depression wide but not deep, meeting the apices of the costae widely at its base.

HAB. Hawaii, Kona district (600 to 2000 ft.). A single example (♀) taken in the mountains of Molokai (3000 ft.) nearly agrees with the Hawaii specimens, as also one from the mountains of West Maui.

(10) *Odynerus orbus*, sp. nov.

Niger, mandibulis rufis, alis caeruleo-iridescentibus. Capitis vertex incrassatus. Clypeus ad apicem depressus, levissime emarginatus. Mesonotum haud nitidum, distincte (nec grosse) punctatum. Propodeum obscure punctatum. Abdominis segmentum 2 a basi elevatum, subtus depressione lata et alta, lateribusque suis post costas subfortiter elevatis. ♀. Long. 10—11 mm. (Plate I. fig. 17 and 17 *a*.)

Black, the mandibles red, the wings with blue iridescence. Clypeus with a depression at the apex, which is very slightly emarginate. Head above the antennae distinctly and closely punctured, the vertex somewhat strongly incrassate. Mesothorax dull, distinctly but not coarsely punctured; scutellum with fine and feeble puncturation. Propodeum with some evident but very feebly impressed coarse punctures. Abdomen with the second segment, raised from the base but not at all abruptly, beneath with the depression wide and deep, the segment at the sides rising abruptly and rather strongly above the apices of the costae.

HAB. Hawaii, Kona (2000 ft. and upwards). Rare. Kilauea (4000 ft.). 1 ♀.

(11) *Odynerus caenosus*, sp. nov.

Niger, alis infuscatis caeruleo-iridescentibus, abdominis segmenti primi et secundi margine apicali flavo-albido. Frons capitis densissime rugoso-punctata. Mesonotum cum scutello fortiter denseque punctatum, subnitidum. Propodeum rugosum. Abdominis segmentum secundum a basi elevatum, subtus depressione haud lata, lateribusque suis abrupte supra costarum apices subfortiter elevatis. Long. 8—9½ mm.

Black, the two basal segments of the abdomen with an apical creamy-white band, the second being the wider of the two. The front of the head is very densely rugosely punctured, the mesothorax coarsely and closely punctured, the surface shining. The propodeum is rugosely sculptured. Basal segment of the abdomen shining, coarsely and closely punctured; the second raised from the base above; beneath, the depression is narrow and hardly meets the apices of the costae, the segment at the sides being abruptly raised from these to about the height of its basal portion.

HAB. Mountains of Kauai. Halemanu and elsewhere on the high plateau.

(12) *Odynerus leucozonias*, sp. nov.

Praecedenti simillimus, et eodem colore, sed mesonoto magis nitido, propodeo laevi (punctato), et abdominis segmento secundo fortius et abruptius elevato, bene distinctus. ♂ ♀. Long. 8—10 mm.

Very similar to the preceding in form and colour.

The surface of the head in front, the mesothorax and scutellum, are very smooth and shining between the punctures, the system of minute punctures between the larger ones on the mesothorax being hardly observable, instead of very distinct. The propodeum is much smoother, with shallow but distinct punctures, and the second segment of the abdomen is more strongly and abruptly raised from the base.

HAB. Kauai (2000—3000 ft.). Found also on the high plateau.

(13) *Odynerus eludens*, sp. nov.

Praecedenti simillimus, margine apicali segmenti abdominis primi angustissime pallido. Mesonotum nitidum fortiter punctatum, interstitiis evidenter minutissime punctatis. Propodeum laeve, antice sparsim subobsolete punctatum, concavitate fere impunctata. Abdominis segmentum primum (a latere visum) a basi usque ad marginem apicalem aequaliter curvatum. ♀. Long. 9·5 mm.

Allied to the two preceding species but with the basal segment of the abdomen (viewed laterally) more evenly and gradually curved from the petiole—not abrupt in front. The mesothorax is smooth and shining between the punctures as in *O. leucozonias*, but the interstices have the minute system of punctures very evident. The propodeum in front is somewhat shining, with some very feebly impressed punctures; the concavity is smooth and almost impunctate. The pale apical band of the basal segment of the abdomen is unusually narrow; the second segment is considerably, but by no means abruptly, raised from the base, the highest point attained (as seen in lateral view) being rather more than one-third of the whole length of the segment from the base. Beneath, the depression somewhat narrow, deeper than in the two preceding species.

HAB. Halemanu, Kauai (4000 ft.). 1 ♀.

(14) *Odynerus homochromus*, sp. nov.

Niger, abdomine fasciis duabus albidis, secunda latiore. Mesonotum fortiter punctatum, interstitiis nitidis, distincte punctulatis. Propodeum opacum subobsolete punctatum, concavitate rugulosa, haud evidenter punctata. Segmentum secundum abdominis fere ad medium subfortiter elevatum, subtus depressione distincta. ♂ ♀. Long. $8\frac{1}{2}$—$12\frac{1}{2}$ mm.

Black, with two pale bands on the abdomen. Thorax strongly punctured, mesothorax shining between the punctures, the minute system between these quite distinct. Propodeum dull with shallow puncturation in front, the concavity almost or quite impunctate with finely rugulose surface. Abdomen with the basal segment evenly punctured, subvertical in front; second segment raised from the base but not abruptly, the highest point being nearly at its middle; beneath with a distinct and neither very narrow nor deep depression.

HAB. Mountains of Kauai (3000 ft.). Not common.

(15) *Odynerus kirbyi.*

Odynerus kirbyi, Dalla Torre, Wien. Ent. Zeitg. VIII. (1889), p. 125.
Odynerus extraneus, Kirby, Ent. Mo. Mag. XVII. p. 86 (nec de Saussure). Blackburn and Cameron, P. Manch. Soc. Vol. XXV. (1885–86), p. 151.

Niger, abdomine fasciis duabus albidis ornato, secundo latiore. ♂ clypeo albido, apice emarginato, mandibulis albido-notatis. Mesonotum fortiter denseque punctatum. Propodeum rugosum. Abdominis segmentum primum dense punctatum, secundum subtus costis fortibus et longis, depressione nulla. ♂ ♀. Long. 9—12 mm. (Plate I. fig. 18—18 *b*.)

Black, with two whitish abdominal bands. The ♂ has also the clypeus and more or less of the mandibles of the same colour. The head in front is exceedingly densely punctured, the mesothorax and scutellum are also densely and coarsely punctured, and the surface between the punctures is shining. The entire propodeum is rugose. Abdomen with the basal segment closely punctured, more coarsely in the ♂ than the ♀; second raised from the base rather strongly in the ♂; beneath, the costae are strong and very long and there is no depression beyond their apices.

HAB. Kauai, in the mountains. Not rare.

(16) *Odynerus dilatatipes*, sp. nov.

Praecedenti simillimus, eodem modo ornatus, mesonoto fere opaco minus dense et grosse punctato; propodei concavitate laeviori, tantum rugulosa; tibiis posticis ♂ ad apices fortiter dilatatis, et externe fortiter depressis, bene distinctus. ♂♀. Long. 9½—11 mm. (Plate I. fig. 19.)

Extremely like the preceding in general appearance. Male with the head, above the antennae, more finely and shallowly punctured, as likewise the mesothorax and scutellum. The propodeum is much less rugose; its concavity almost smooth, except for the surface rugulosity. Basal segment of the abdomen with the dorsal and anterior faces meeting less sharply, and less coarsely and closely punctured. Female with the head and thorax evidently more finely punctured, and the surface of the latter dull, or almost dull, between the punctures. The posterior concavity of the propodeum is smoother, and the basal segment of the abdomen more finely punctured. The ♂ is further distinct from any other species by the strongly and suddenly dilated apex of the hind tibiae, the dilated portion outwardly being deeply concave.

Hab. Mountains of Kauai (3000 ft.). Not a common species.

(17) *Odynerus conifer*, sp. nov.

Niger, abdomine fasciis duabus albidis ornato. Mesonotum nitidum sparsim subtilius punctatum. Propodeum rugoso-punctatum. Abdominis segmentum primum supra fortiter transversum, antice truncatum, parte antica parti dorsali acute occurrente; segmentum secundum acute conicum, subtus costis longis, depressione nulla. ♀. Long. 9 mm.

Head closely punctured. Mesothorax smooth and shining, somewhat finely punctured, remotely and irregularly on the posterior half. Between these punctures the minute system of puncturation is very distinct. Propodeum with shallow and somewhat rugose puncturation. Abdomen with the basal segment strongly transverse above, depressed, and distinctly punctured, sharply truncate in front; second segment strongly raised into a sharp cone, beneath the middle costae very long, and no depression beyond their apices.

Hab. Kauai, on the high plateau. A very remarkable and rare species, of which only 1 ♀ was taken.

(18) *Odynerus kauaiensis*, sp. nov.

Niger, fasciis duabus albidis ornatus. Mesonotum densissime grosse punctatum. Propodeum fortiter rugoso-punctatum. Abdominis segmentum primum ad basim puncturatione grossissima rugosum; secundum haud elevatum; subtus, costis longis; post has triangulariter deplanatum, vix depressum. ♂♀. Long. 8—10 mm.

Apex of clypeus very slightly emarginate or truncate. Mesothorax and scutellum coarsely and closely punctured, the surface between the punctures shining. Propodeum with a coarse rugose puncturation. Basal segment of the abdomen very coarsely punctured towards the brow, less so near the apical margin; second segment simple above, not raised from the base, but with only the ordinary longitudinal convexity; beneath with the costae long, followed by no distinct depression, but usually somewhat flattened triangularly in its place.

HAB. Mountains of Kauai. Not common.

(19) *Odynerus peles*, sp. nov.

Niger, peropacus. Mandibulae fere totae nigrae. Clypeus levissime emarginatus vel truncatus. Capitis et mesonoti puncturatio fere obsoleta. Propodeum rugosum vel rugoso-punctatum. Abdominis segmentum secundum haud elevatum, tantum longitudinaliter convexum; subtus, depressione distincta, minus alta. ♂ ♀. Long. 6—9 mm.

Male black, the abdomen never with yellow bands. Mandibles dark, the extreme apex sometimes reddish or piceous. Apex of clypeus slightly emarginate or truncate.

Head and thorax very dull, with shallow subobsolete puncturation, sometimes almost invisible. Mesothorax not clothed with a silky pile, but with a very short erect pubescence, easily seen in lateral view. Propodeum rugose, generally more or less reticulately so, the rugosities being apparently the interstices between large shallow punctures, hardly now to be recognized as such. Abdomen dull, the basal segment with very shallow punctures; the second simply convex above, not raised from the base, beneath with the depression somewhat wide at its base but not deep.

Female very like the ♂, with obscure puncturation, the interstices between the punctures of the mesothorax very dull, and the minute punctures thereon not very distinct and somewhat scattered and remote from each other.

HAB. Kona and Kau districts (2000—4000 ft.) of Hawaii. Not a rare species.

OBS. This species greatly resembles the following, but the ♂ is abundantly distinct by the form of the clypeus and the different form of the mesothoracic pubescence. The ♀ may be known by the very slightly emarginate or truncate apex of the clypeus and the different sculpture of the surface of the mesothorax, which in the following has the minute system of punctures very dense and distinct.

(20) *Odynerus sociabilis*, sp. nov.

Niger, ♂ sericeo-pubescens. Margo segmenti primi et secundi (vel unius ex his) apicalis saepe anguste flavus. Mandibulae ex majore parte rufae. Clypeus fortiter dentato-emarginatus. Mesonotum puncturatione obsoleta vel fere obsoleta. Propodeum puncturatione subobsoleta rugosum. Abdominis segmentum secundum subtus depressione lata, minus alta. ♀ minus sericeo-pubescens. Clypeus minus fortiter sed distincte emarginatus. Mesonotum subtiliter remote punctatum (puncturatione nonnunquam fere obsoleta), interstitiis distincte densissime punctulatis. Mandibulae plerumque rufae. ♂♀. Long. 6½—10½ mm. (Plate I. fig. 20.)

Male black, dull, with an appressed sericeous pubescence, often with the apical margin of the first and second abdominal segments narrowly yellow, or with one or other of them so coloured. Mandibles for the most part red. Clypeus very deeply emarginate, the emargination forming rather more than a semicircle. Head above the antennae dull, finely and feebly subobsoletely punctured. Mesothorax and scutellum with an appressed pubescence concealing the surface which is hardly visibly punctured. Propodeum with feeble subobsolete punctures, giving it generally a reticulately rugose appearance in front. Abdomen dull, with sericeous pubescence, and very feebly punctured. Second segment simple above, not raised from the base; beneath with the depression shallow, meeting the apices of the costae widely, the surface dull, somewhat evenly punctured beyond the depression.

Female rather unlike the ♂, much less densely clothed with sericeous pubescence. Mandibles entirely red, or more or less dark. The clypeus, although distinctly dentately-emarginate, is much less deeply so than that of the ♂. Mesothorax dull, with fine sparse punctures, nearly obsolete in some examples, in others more distinct; between these there is an exceedingly close and distinct minute puncturation. Propodeum rugosely punctate as in the ♂. Abdomen less dull, owing to the pubescence being much less dense.

Hab. Mountains of Maui and Hawaii in open localities from 4000—10,000 ft. Common.

(21) *Odynerus scoriaceus*, sp. nov.

Praecedenti cognatissimus. ♂ margine apicali segmentorum 2 basalium flavo, nonnunquam etiam pronoto postscutello, tegulisque flavo-notatis. Mandibulae rufae. Frons dense subgrosse (nec fortiter) punctata. ♂ mesonoto distinctius punctato, ♀ fronte dense distincteque, scutello evidenter subtiliter punctato, discernenda. ♂♀. Long. 7—11 mm.

Very like the preceding which it exactly resembles in form. ♂ with two basal segments apparently always pale along their apical margins. The prothorax, postscutellum and tegulae are also sometimes spotted with yellow; the mandibles are red. The head above the antennae is more largely and closely and less obsoletely punctured, than that of the preceding, the sericeous pubescence of the thorax is less dense and the puncturation larger and more distinct. In the ♀ the mandibles are also red, the head above the antennae is closely and distinctly punctured, the mesothorax is less dull, and more strongly punctured, the minute interstitial puncturation less extremely dense, and the scutellum is sparsely and finely but evidently punctured.

HAB. Kona, Hawaii, on the coast and in the mountains (4000 ft.).

(22) *Odynerus molokaiensis*, sp. nov.

Praecedenti simillimus. Fasciae abdominis ♂ 2 pallidae plerumque plus minusve obsoletae. Pronotum cum tuberculis, tegulae, scutellum, postscutellum, et clypeus nonnunquam flavo-notata, vel haec omnia nigra. ♂♀ fronte fortius punctata; ♀ mesonoto nitido, distinctissime punctato, distinguenda. ♂♀. Long. 7—10 mm.

Extremely like the preceding, of similar form and the mandibles red in both sexes. ♂ with the head in front evidently less shallowly punctured. The abdominal bands are generally more or less obsolete, and in a series of specimens much less evident, than in the preceding species. On the other hand sometimes not only the prothorax, tegulae and postscutellum are marked with yellow, but also the clypeus, the tubercles of the prothorax, and the scutellum. The ♀ is quite distinct by the closely and deeply punctured head in front, and the entirely shining surface of the thorax, with its very distinct puncturation.

HAB. Molokai mountains (3000 ft.).

(23) *Odynerus smithii.*

Odynerus agilis, Smith, J. Linn. Soc. XIV. p. 681 (nec Smith, op. cit. III. p. 164). Blackburn and Cameron, P. Manch. Soc. XXV. p. 162.

Odynerus smithii, Dalla Torre, Wien. Ent. Zeitg. VIII. (1889), p. 124.

Niger, alis minus infuscatis, haud evidenter caeruleo-iridescentibus. Mandibulae nigrae. Frons post antennas flavo-notata. ♂ fasciis duabus abdominis pallidis distinctis, clypeo fortiter emarginato, mesonoto dense aequaliter punctato. ♀ mesonoto opaco, (antice saltem) dense aequaliter punctato; segmento abdominis 2 ventrali post costas levissime (late tamen) depresso. ♂♀. Long. $6\frac{1}{2}$—$9\frac{1}{2}$ mm.

Allied to the several preceding species, but of smaller average size. Black, with a small median yellow spot just behind the antennae. The mandibles are dark. The ♂ has the two basal segments of the abdomen distinctly bordered with yellow along their apical margins, and they are obscurely and very narrowly pale in the single ♀, which I have examined.

♂ clypeus deeply emarginate, head above the antennae dull, closely punctured. Thorax black, entirely dull; mesothorax without sericeous appressed pubescence, closely, evenly, and distinctly punctured, the interstices with a dense minute puncturation. Scutellum with a very similar puncturation. Propodeum rugose from large subobsolete punctures.

♀ with the head above the antennae closely punctured, the interstices with very distinct minute puncturation. Mesothorax dull, closely and evenly punctured at least on the front half, the minute system of punctures between the larger ones, very dense and distinct. Scutellum more finely, but distinctly punctured. Propodeum as in the ♂. Basal segment of the abdomen with shallow even puncturation, second simple above, beneath, with the depression wide at the base but very faint.

Hab. Lanai, on the coast, and Wailuku, Maui.

The specific name 'agilis' given to this species by Smith had already been used by him for a species of the same genus found in the Aru Islands.

(24) *Odynerus nubicola*, sp. nov.

Niger, opacus, alis subhyalinis, vix iridescentibus; frons cum pronoto plerumque flavo-notata. Abdominis segmentum primum et secundum margine apicali flavo. Clypeus leviter emarginatus. Mesonotum opacum, antice subaequaliter, post medium sparsim, obscure punctatum. Abdominis segmentum secundum haud elevatum, subtus depressione levissima, nonnunquam fere obsoleta. ♂♀. Long. 7—9 mm. (Plate I. fig. 21 and 21 *a*.)

Black, a median spot behind the antennae, two on the prothorax (rarely absent), and the apical margin of the two basal abdominal segments, yellow. Mandibles dark. Clypeus in both sexes emarginate at the apex, but not deeply, very convex longitudinally. Head above the antennae dull, especially in the ♂, with both systems of puncturation evident. Mesothorax very densely and finely punctured between the larger punctures, which are very shallow and subobsolete, and still further obscured in the ♂ by the appressed fuscous pubescence. The larger punctures themselves are sparse and irregular on the posterior half of the mesothorax, but more regular in front. Abdomen with the basal segment coarsely and shallowly subrugosely punctured; second simply convex above, beneath, with the depression very feeble, often hardly evident except for a median longitudinal impressed line, the segment rising from the apices of the costae only with the slight convexity of its surface. The wings in both sexes are subhyaline with hardly any iridescence.

Hab. Haleakala, Maui. Common above the forest belt up to the summit, and also within the crater.

(25) *Odynerus ecostatus*, sp. nov.

Niger et nitidus, alis caeruleo-iridescentibus. Mandibulae ex majore parte rufae. Clypeus vix emarginatus. Mesonotum antice aequaliter, postice circa medium sparsim, distincte punctatum. Abdominis segmentum primum minus dense punctatum; secundum a basi elevatum, subtus, costis obsoletis, (vel fere obsoletis), sulco nitido. ♂♀. Long. 8—10 mm. (Plate I. fig. 22 and 22 *a*.)

Black and shining, the wings dark with bright blue iridescence. Mandibles for the most part red. Clypeus very slightly emarginate in the ♂, the head above the antennae densely punctured. Mesothorax shining, with distinct regular punctures in front, which posteriorly towards the middle become scanty. Scutellum punctured, more largely in the ♂ than the ♀; propodeum smooth and punctured. Abdomen shining, basal segment very distinctly, but not densely punctured; the second raised from the base but not abruptly; beneath with the costae obsolete or nearly so, the sulcature very shining, the depression meeting it rather widely, and the sides of the segment rather abruptly raised from it, though not strongly, hardly attaining the height of its basal portion.

Hab. Molokai, Lanai and Maui, in the mountain forests (2000—4000 ft.).

(26) *Odynerus montanus.*

Odynerus montanus, Smith, J. Linn. Soc. xiv. p. 680. Blackburn and Cameron, P. Manch. Soc. xxv. p. 158.

Niger, subnitidus, alis caeruleo-iridescentibus. Clypeus vix emarginatus. Mesonotum subnitidum, distincte minus dense punctatum. Propodeum opacum et rugosum. Abdominis segmentum secundum plus minusve (♂ subfortiter) elevatum; subtus, depressione lata, minus alta. ♂♀. Long. 7—11 mm.

Black, somewhat shining, wings dark and brightly iridescent. Clypeus hardly emarginate at the apex. Head above the antennae deeply, closely and distinctly punctured (rather more largely in the ♂). Mesothorax rather shining, distinctly but not coarsely punctured, somewhat remotely in the ♀, more closely and rather more largely in the ♂. The minute interstitial puncturation is shallow and not dense, but very evident. Propodeum dull or nearly so, and rugose. Abdomen with the basal segment distinctly and evenly punctured; second raised from the base, more strongly but not very abruptly in the ♂; beneath, with the depression shallow, but rather wide; the costae well developed.

Hab. Oahu, on the coast and in the mountains.

(27) *Odynerus unicus*, sp. nov.

♂ niger, nitidus, alis caeruleo-iridescentibus. Clypeus levissime emarginatus. Frons minus fortiter punctata. Mesonotum subnitidum, sparsim subtiliter punctatum. Propodeum laeve, antice (ad latera) impunctatum, concavitate sparsim minus fortiter punctata. Abdominis segmentum secundum elevatum; subtus, costis subobsoletis, a sulco fortiter elevatum, depressione angustula, minus alta. ♂. Long. 7 mm.

Black, shining, wings dark with blue iridescence. Clypeus very slightly emarginate at its apex; head above the antennae rather finely and shallowly punctured. Mesothorax with fine sparse and irregular punctures, between which the minute system is evident, but not dense. Propodeum smooth, impunctate in front, the posterior concavity with some very shallow punctures. Basal segment of the abdomen, viewed laterally, forming an almost even curve from the petiole to the hind margin, above somewhat irregularly and shallowly punctured. Second segment raised from the base; beneath, the depression neither very wide nor deep, the costae subobsolete, and the segment rising at the side from their apices to a height rather greater than that of its basal portion. ♂.

Hab. Mountains near Honolulu. 1 ♂, March 1897.

(28) *Odynerus camelinus*, sp. nov.

Niger, fronte post antennas rubro-notata, tegulis rubris; ♂ clypei apice, mandibulis, pronoto et postscutello nonnunquam rubro-notatis; alis caeruleo-iridescentibus. ♂ clypeus fortiter, ♀ levissime emarginatus. Caput post antennas opacum, distincte punctatum. Mesonotum vix nitidum, sparsim subtiliter obscurius punctatum, densissime etiam et minutissime punctulatum. Abdominis segmentum primum fere impunctatum, secundum fortiter elevatum, coniforme; subtus depressione lata, leviter impressa. ♂♀. Long. 7—10 mm. (Plate I. fig. 23 and 23*a*.)

Black, a median spot behind the antennae and the tegulae red. In the ♂ some or all of the following parts are also of this colour; the mandibles, the apex of the clypeus, the apex of the anterior and intermediate femora, the prothorax in front and part of the postscutellum.

Clypeus of ♂ deeply, of ♀ slightly emarginate at the apex. Head above the antennae distinctly punctured, the interstices with very distinct minute punctuation. Mesothorax scarcely shining, very feebly and sparsely punctured, with a very minute and close puncturation between the larger punctures. Propodeum almost dull, smooth and scarcely punctured. Abdomen with the basal segment strongly transverse, with very feeble, ill-defined, and sparse punctures; second segment strongly raised from the base into a conical form; beneath, with the depression wide and very shallow, in the middle the surface depressed even a little below the level of the apices of the costae.

Hab. Molokai Mts. (2000—4000 ft.). Maui, Iao Valley, above Lahaina, and on Haleakala.

(29) *Odynerus dromedarius.*

Odynerus dromedarius, Blackburn, P. Manch. Soc. xxv. (1885–86), p. 151.

Praecedenti cognatissimus, sed tegulis atris: mesonoto magis opaco. ♂ apice tibiarum et clypei, mandibulis pronoto et postscutello nunquam rufo-notatis. ♂♀. Long. 8—9 mm.

Differs very little from the preceding except in colour. The ♂ has no red markings except the small median spot behind the antennae and those behind the eyes. In the ♀ the former is sometimes absent and in both sexes the tegulae are always dark.

The surface of the thorax is rather more dull, the minute system of punctuation being rather more dense, and generally the puncturation, especially of the scutellum, is slightly better defined.

Hab. Kona, Hawaii (3000—4000 ft.). Kilauea (4000 ft.).

(30) *Odynerus oahuensis*, Dalla Torre.

Odynerus diversus, Blackburn, P. Manch. Soc. xxv. p. 161 (nec Walker).
Odynerus oahensis (sic), Dalla Torre, Wien. Ent. Zeitg. viii. (1889), p. 124.

Niger, alis ex majore parte subhyalinis, haud caeruleo-iridescentibus. Frons, pronotum, tegulae, mesopleurae, scutellum, et postscutellum rubro-notata. Abdominis segmentum primum et secundum postice rubro-marginata, hujus etiam lateribus rubro-maculatis. Segmenta caetera etiam saepe plus minusve rubro-marginata.

♂ clypeo fortiter, ♀ vix emarginato. Mesonotum subnitidum, fortiter punctatum. Propodeum laeve, parce subobsolete punctatum. Abdominis segmentum primum fortiter transversum: secundum convexum, haud a basi elevatum, lateribus fortiter rotundatis; subtus post costas late triangulariter deplanatum, vix depressum, costis distinctis. ♂♀. Long. 8—10 mm.

Black, with a red median spot behind the antennae and another behind each eye. The prothorax, tegulae, mesopleurae, scutellum and postscutellum are spotted with red. The apical margin of the first and second abdominal segments as well as the sides of the latter are of the same colour, and some of the following segments are more or less red along their apical margins.

Clypeus of ♂ strongly, of ♀ hardly emarginate. Head above the antennae coarsely and very closely punctured. Mesothorax rather more largely but not quite so closely. Scutellum sparsely punctured. Propodeum with the surface smooth, bearing some very shallow punctures. Abdomen with the basal segment strongly transverse above; second strongly convex longitudinally, but not raised, its sides strongly rounded; beneath, widely flattened beyond the costae, hardly depressed, not raised up from their apices even at its sides, the costae themselves well developed. Wings subhyaline, the front pair infuscate along the anterior margin, but without any blue iridescence.

Hab. Oahu, both mountain ranges. Not common.

(31) *Odynerus rudolphi.*

Odynerus cardinalis, Blackburn, P. Manch. Soc. xxv. p. 158 (nec Morawitz).
Odynerus rudolphi, Dalla Torre, Wien. Ent. Zeitg. viii. (1889), p. 124.

Niger, nitidus, alis purpureo-iridescentibus. Clypeus vix emarginatus. Mesonotum sparsim subtiliter sed distincte punctatum. Propodeum laevissimum. Abdominis segmentum secundum ventrale haud supra costarum apices ad latera elevatum, costis fortibus, depressione nulla. ♂♀. Long. 7—9 mm. (Plate I. fig. 24 and 24*a*.)

Deep black and shining, generally with a minute yellow spot behind the antennae and another behind each eye near the vertex. Wings infuscate with extremely bright iridescence.

Clypeus hardly emarginate at the apex; head above the antennae distinctly but not so very closely punctured. Mesothorax finely remotely and distinctly punctured, the surface very highly polished, and the minute system of punctures extremely feeble and almost obsolete. Propodeum very smooth, shining, and with at the most a few very fine punctures. Abdomen with the basal segment, seen from the side, evenly curved from the petiole to the hind margin; second segment strongly convex longitudinally; beneath flat, with no distinct depression, the costae strong, and the segment at the sides not rising up from their apices.

Hab. Mountains and coast of Oahu. Not rare.

(32) *Odynerus brevicostatus*, sp. nov.

♂ niger, mandibulis rufis, alis nitide fuscis, margine antico tantum purpureo-iridescente. Clypeus vix emarginatus. Mesonotum subnitidum, inaequaliter subtiliter punctatum. Propodeum nitidum fere impunctatum. Abdominis segmentum secundum fortiter convexum (haud elevatum); subtus, depressione definita nulla, costis brevissimis, parte sua basali permagna et tumida. ♂. Long. 6½ mm.

♂ black, with the mandibles red, wings infuscate with a purple iridescence. Clypeus truncate at the apex. Mesothorax shining, irregularly, sparsely, and finely punctured, with the minute system of punctures between these larger ones very distinct. Propodeum smooth and shining, hardly punctured. Abdomen shining, basal segment remotely punctured; second not raised from the base except by its longitudinal convexity, which is strong; beneath, with extremely short costae, the basal portion of the segment in front of these very greatly developed, tumid and shining; beyond the costae the segment is nearly flat, not at all raised from their apices, and without any definite depression.

HAB. Molokai mountains (3000 ft.). 1 ♂ taken.

(33) *Odynerus eupteryx*, sp. nov.

♂ praecedenti simillimus, niger, mandibulis atque clypei apice rufis, alis caeruleo-iridescentibus. Clypeus levissime emarginatus. Frons opaca, puncturatione fere obsoleta. Mesonotum opacum subobsolete punctatum. Propodeum dense minutissime rugulosum, opacum, fere impunctatum. ♂. Long. $7\frac{1}{2}$ mm.

Closely allied to the preceding, having the second ventral segment of the abdomen very similarly formed, but with the costae rather longer and the tumid basal portion of the segment less shining. Otherwise it may easily be distinguished by the following characters. The extreme apex of the clypeus is red, as well as the mandibles, the head above the antennae is very obscurely punctured, the thorax quite dull, the larger system of punctures very feebly impressed, and the minute system much less distinct. The propodeum dull, with a very minute and dense surface rugulosity. The wings are darker with a bright blue iridescence.

HAB. Molokai mountains (3000 ft.). 1 ♂ taken.

(34) *Odynerus purpurifer*, sp. nov.

Niger, nitidus, mandibulis clypeique apice rufis; alis fuscis, purpureo-iridescentibus. Clypeus dentato-emarginatus. Mesonotum nitidum, subtilius minus dense punctatum. Propodeum nitidum, sparsim subobsolete punctatum. Abdominis segmentum secundum (praecipue ♂) subelevatum; subtus, post sulcum transversum fortissime elevatum, costis subobsoletis. ♂♀. Long. 7—11 mm. (Plate I. fig. 25 and 25 *a*.)

Black and shining, the mandibles and apex of clypeus red, wings shining fuscous with purple iridescence. Head above the antennae closely and distinctly punctured, the vertex in the ♀ somewhat incrassate. Mesothorax with scattered punctures, the surface between them with the minute system very distinct, but not dense. Propodeum in front shining, with a few feebly impressed punctures. Abdomen with the basal segment not densely punctured; second raised from the base in the ♂, but not strongly or abruptly, and still less so in the ♀; beneath, the costae obsolete or nearly so, the sulcature shining, and the part of the segment beyond it strongly and abruptly raised to a height greater than that of its basal portion, its depression narrow but deep in front.

HAB. Molokai mountains (3000—4000 ft.). Mountains of West Maui in the Iao Valley, and above Lahaina (3000 ft.). Lanai (2000 ft.).

(35) *Odynerus instabilis*, sp. nov.

Niger, mandibulis rufis, alis infuscatis caeruleo-iridescentibus. Caput densissime punctatum. Mesonotum subfortiter punctatum, ♀ postice irregulariter, interstitiis crebre minutissime punctulatis. Propodei concavitas punctata. Abdominis segmentum secundum basi subfortiter elevatum; subtus, post sulcum fortiter elevatum, depressione angusta sat distincta.

VAR. Tegulis rufis vel piceis. ♂♀. Long. 7—9·5 mm.

This species is very variable but quite distinct from any other. The surface in some examples is quite dull, (especially in examples from Molokai), while in others it is very shining. The mandibles are red, the head above the antennae densely, but not very deeply punctured. The mesothorax is distinctly punctured, rather more coarsely in the ♂, and somewhat sparsely and irregularly on the posterior portion in the ♀. The propodeum is not rugose, but the posterior concavity is punctured. The second segment of the abdomen is distinctly raised from the base; beneath, it rises up very strongly from the sulcature to an elevation much greater than its basal portion, and there is a narrow but very distinct median depression. The wings are dark, and have a blue iridescence. In examples from Maui the tegulae are generally red, but in a few examples they are dark, as in the Lanai and Molokai specimens.

HAB. Molokai, Lanai, and Maui, in the mountain forests (2000—5000 ft.).

(36) *Odynerus deinogaster*, sp. nov.

Niger, subnitidus, fronte, pronoto, et nonnunquam postscutello rubro-notatis, alis infuscatis, caeruleo-iridescentibus. Caput, mesonotum, concavitasque propodei dense fortiter punctata. Abdominis segmentum primum dense punctatum; secundum supra convexum, haud a basi elevatum; subtus, sulco transverso nitidissimo, post sulcum fortissime abrupte elevatum, costis et depressione obsoletis. ♂♀. Long. 7—8 mm. (Plate I. fig. 26 and 26*a*.)

Black, with a spot behind the antennae, the prothorax in front and sometimes the postscutellum, red. Abdomen entirely black. Wings infuscate and with a blue iridescence. Clypeus hardly emarginate at the apex; head above the antennae densely punctured. Mesothorax with a somewhat coarse and close puncturation, the surface somewhat shining and the system of minute punctures evident. Abdomen with the basal segment closely and distinctly punctured; second simply convex longitudinally above; beneath, the sulcature shining, without any costae, and the part of the segment behind it very strongly and abruptly raised, subprominent in the middle in front, the depression wanting.

HAB. Molokai mountains (3000 ft.). Rare. 2 ♂ 2 ♀ taken.

(37) *Odynerus homœogaster*, sp. nov.

Praecedenti forma similis, sed antennarum articulo basali antice, et margine segmenti primi abdominis postice, rubris. ♂♀. Long. 8—9 mm.

Perhaps only a subspecies of the preceding, but readily distinguished by the red line on the scape of the antennae in front, and the red apical margin of the basal abdominal segment. In the ♀ the abdominal band is interrupted, and less conspicuous than that of the ♂.

HAB. Iao Valley, Maui. 4 ♂ 1 ♀.

(38) *Odynerus heterochromus*, sp. nov.

Niger, opacus, alis caeruleo-iridescentibus. Abdominis segmentum secundum ut in O. homœogasteri fere formatum. Thorace opaco et colore bene distinguendus.

VAR. ♂. Segmentum abdominis basale postice flavo-marginatum. ♂♀. Long. $6\frac{1}{2}$—$8\frac{1}{2}$ mm.

Black, ♂ very rarely with the apical margin of the basal segment of the abdomen pale, and sometimes with a small pale median spot just behind the antennae.

Apex of the clypeus slightly dentately-emarginate; head above the antennae dull with shallow and very close puncturation. Mesothorax dull, rather coarsely punctured in the ♂, in the ♀ the punctures are finer, sparser and less distinct. Scutellum in the ♂ closely punctured, less closely and much more finely in the ♀. Propodeum towards the sides in front rough with large shallow feebly-impressed punctures. Abdomen with the basal segment closely, but not deeply, punctured; second segment above not raised from the base; beneath, exceedingly strongly raised from the sulcature, the costae subobsolete, and the depression wanting, or represented only by a faint longitudinal impressed line.

HAB. Kilauea, Hawaii (4000 ft.). Common; burrows in dead tree trunks. I did not meet with it on the leeward side of the island.

(39) *Odynerus mimus*, sp. nov.

Forma fere praecedentis, niger, abdominis segmentis duobus basalibus postice albido-marginatis, alis infuscatis caeruleo-iridescentibus. Mesonotum nitidum, dense fortiter punctatum. Abdominis segmentum secundum supra haud elevatum, leviter convexum; subtus, post sulcum fortissime elevatum, costis subobsoletis, depressione nulla. ♂ ♀. Long. $7\frac{1}{2}$—9 mm.

Not a large species, agreeing for the most part in form with the preceding. Black, with the apical margins of the first and second abdominal segments yellowish-white. The first band narrow, the second much wider.

Head and mesothorax densely and coarsely punctured, the surface of the latter shining between the punctures. Propodeum with the surface smooth and shallowly punctured. Basal segment of the abdomen evenly punctured; second simple above, slightly convex longitudinally; beneath, extremely strongly and abruptly raised from the sulcature (the greatest height attained being at the middle), the costae more or less obsolete, the depression wanting, or represented only by an impressed line.

HAB. Mountains of Kauai (3000 ft.).

(40) *Odynerus pseudochromus*, sp. nov.

Niger, capitis fronte, pronoto, mesopleuris, tegulis (saepe), scutello, et postscutello rubro-notatis. Abdominis segmentorum margines apicales, (duorum basalium distinctissime), rubri. Alae fere hyalinae, marginibus anticis et apicalibus infuscatis. Mesonotum cum scutello dense fortiter punctatum. Abdominis segmentum secundum minus elevatum, fortiter convexum; subtus, fortissime post sulcum elevatum, depressione distincta, minus lata. ♂ ♀. Long. 6—$8\frac{1}{2}$ mm. (Plate I. fig. 27 and 27 *a.*)

Black, with a median spot behind the antennae, another behind each eye, the prothorax in front, a spot on the mesopleurae, a small one on the mesothorax near the tegulae, one or more spots on the latter, part of the scutellum and postscutellum, the hind margins of most of the abdominal segments (the first and second most widely), and a line on the scape of the antennae of the ♂, red. These markings vary a little but are for the most part constant. Wings nearly clear, except along the margin, and with no trace of blue iridescence.

Apex of clypeus with a depression, but hardly emarginate. Mesothorax coarsely and densely punctured, the scutellum closely but rather less coarsely. Propodeum with shallow puncturation. Basal segment of the abdomen densely punctured; second somewhat strongly convex, especially in the ♂; beneath very strongly and abruptly raised behind the sulcature, the costae ill defined, subobsolete, the depression very distinct, deep in front, the segment prominent on either side of it.

HAB. Mountains of Oahu, both ranges.

OBS. This species has a most remarkable resemblance superficially to *O. oahuensis*. It is less robust and lacks the red spot on the sides of the second segment of the abdomen. The second ventral segment is as different as it well can be, and there are other important structural differences, so that I believe the two species are not really at all closely related; yet their general appearance is extremely similar, and unlike other Hawaiian species.

(41) *Odynerus leiodemas*, sp. nov.

Praecedenti simillimus, eodem modo rubro-notatus, sed angustior. Mesonotum minus dense punctatum, scutello sparsius ac subtilius. Abdominis segmentum secundum subtus minus fortiter post costas elevatum. ♀. Long. $7\frac{1}{2}$ mm.

This species is exactly like the preceding in its markings and the colour of the wings, but is evidently narrower in form. The mesothorax is more finely and less regularly punctured and more shining, the scutellum more finely and sparsely. The second segment of the abdomen more strongly convex at the base longitudinally (when seen from the side), while beneath it is evidently less strongly raised from the sulcature.

HAB. Waianae mountains, Oahu. A single ♀ taken.

(42) *Odynerus laevisulcatus*, sp. nov.

Niger, nitidus, alis infuscatis caeruleo-iridescentibus, forma gracili. Clypeus vix emarginatus. Capitis vertex subincrassatus; frons densissime punctata. Mesonotum nitidum, antice aequaliter, postice ad medium subsparsim, fortiter punctatum. Propodeum laeve, concavitate sua dense punctata. Abdominis segmentum secundum subelevatum vel fortiter convexum; subtus, post sulcum transversum, ad altitudinem partis suae basalis (vel magis alte) elevatum, depressione angusta distinctissima, sulco ipso nitido, costis fere obsoletis. ♀. Long. 7—8 mm.

Female black, wings infuscate, with blue iridescence. Apex of clypeus hardly emarginate. Head above the antennae very closely punctured, the vertex incrassate. Mesothorax strongly punctured, evenly in front, posteriorly, at least about the middle, somewhat sparsely. The puncturation of the scutellum is also very distinct, but finer than that of the mesothorax. Propodeum with the surface smooth and shining, distinctly but not deeply punctured, densely so in the posterior concavity. Abdomen shining, basal segment with distinct nearly even puncturation; second somewhat raised from the base, or at least very strongly convex; beneath, raised above the sulcature to a height rather greater than that of its basal portion, the sulcature itself shining, with indistinct, nearly obsolete costae, the depression narrow but very distinct.

HAB. Haleakala, Maui (5000 ft.). Two ♀ taken in the early part of 1894; probably rare, as it was not met with again on several subsequent visits.

(43) *Odynerus xanthorhoes*, sp. nov.

Niger, nitidus, alis fuscis, nitidissimis. Abdomen fasciis duabus ferrugineo-flavis. Frons, pronotum, mesopleurae, tegulae plerumque, postscutellum, tibiaeque omnes (plus minusve), eodem colore decorata. Mesonotum (♀ praecipue) remote punctatum, minutissime etiam et dense punctulatum. Propodeum fortiter rugosum. Abdominis segmentum primum ad basim grossissime punctatum; secundum in formam conicam fortiter elevatum. ♂♀. Long. 8—9 mm.

Black, with a median spot behind the antennae, another behind each eye, part of the prothorax, a spot on the mesopleurae, the tegulae more or less, the postscutellum in front, the hind margin of the two basal abdominal segments, all the tibiae more or less, of an orange-yellow colour. Mesonotum shining, the system of larger punctures distinct but not coarse, and on the posterior half the puncturation is sparse and irregular. In the ♀ these punctures are finer than in the ♂ and much more sparing, the system of minute punctures occupying the greater part of the surface. Propodeum with coarse rugose sculpture. Abdomen shining, basal segment very coarsely punctured towards the base; second raised near the base into a conical form; beneath beyond the sulcature also raised to a height equal to, or slightly greater than, that of its basal portion, the depression short and narrow, but distinct.

HAB. Mountains of Kauai (2500—3000 ft.). Local.

(44) *Odynerus nivicola*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus, abdominis segmentis duobus basalibus flavo-marginatis. Clypeus distincte emarginatus. Mesonotum plus minusve nitidum, irregulariter punctatum, interstitiis dense subtilissime punctulatis. Propodeum opacum et rugosum. Abdominis segmentum secundum (praecipue maris) abrupte elevatum; subtus, post sulcum fortiter elevatum, depressione angustula. ♂♀. Long. 6—9 mm.

Black, the wings with blue iridescence, the apical margins of the two basal segments of the abdomen pale yellow.

Clypeus distinctly emarginate at the apex; the head above the antennae closely and distinctly punctured. Mesothorax more or less shining, sparsely irregularly and not coarsely punctured (in the ♀ generally more finely and sparsely than in the ♂); between these punctures with a fine and close puncturation, which is generally clearer in the ♀ than in the ♂. Propodeum dull, and more or less rugose towards the sides. Basal segment of the abdomen with shallow punctures; second abruptly and rather strongly raised from the base; beneath, finely punctured, and abruptly raised from the apices of the costae, the depression narrow.

HAB. Haleakala, Maui. In the higher forest, and above it to an elevation of 8000 ft., and also in the summit crater.

(45) *Odynerus dryas*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus, capite, thorace et abdomine rufo-notatis. Pronotum rufo-maculatum. Abdominis segmentorum 2 basalium apices rufo-marginati. Mesonotum nitidum, sparsim irregulariter punctatum. Abdominis segmentum secundum elevatum; subtus depressione sat lata. ♂♀. 7—8 mm.

Black, the wings infuscate and with blue iridescence. A median spot on the head behind the antennae, two large ones on the prothorax, one below each of the tubercles, sometimes one on each of the tegulae, the postscutellum, two spots sometimes on the scutellum, the propodeum more or less at the sides, of a bright red colour. Basal segment of the abdomen with an apical red band strongly dilated at the sides, and the apical margin of the second of the same colour.

Mandibles black. Clypeus very slightly dentately-emarginate; head above the antennae closely punctured. Mesothorax smooth and shining, somewhat finely irregularly punctured, the surface between these punctures with very minute but quite evident puncturation; scutellum sparsely punctured; propodeum with the posterior concavity closely punctured. Abdomen with the basal segment coarsely and evenly punctured; second raised from the base but not very strongly; beneath, at the sides, raised from the apices of the costae to about the height of the basal portion of the segment, the depression wide but not deep.

HAB. Haleakala, Maui, 5000 ft. 3 ♂ 1 ♀.

(46) *Odynerus erythrostactes*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus, fronte, pronoto, tegulis, mesopleuris et postscutello rubro-notatis. ♂ tibiis anticis saepe, intermediis posticisque rarius, articuloque basali antennarum plus minusve, rubro-lineatis. Abdominis segmentum primum postice rubro-marginatum. ♂-is clypeus leviter, ♀-ae vix emarginatus. Mesonotum subnitidum, distincte punctatum. Propodeum rugosum. Abdominis segmentum secundum fortiter elevatum, lateribus subcompressis; subtus, depressione post costas distincta, minus alta. ♂♀. Long. 7—10·5 mm.

Black, the wings infuscate and with blue iridescence. A median spot behind the antennae, one on either side of the prothorax, nearly united, one or more on the tegulae, one on the mesopleurae, the postscutellum in front, and the hind margin of the basal segment of the abdomen, red. In the ♂ the front tibiae usually, sometimes the intermediate, and rarely the posterior are more or less red, as also a longer or shorter line on the scape of the antennae.

Clypeus of ♂ dentately-emarginate but not deeply. Head above the antennae closely and rugosely punctured. Mesothorax distinctly punctured, less closely and regularly behind than in front, between these punctures with a distinct minute puncturation, the surface more or less smooth and shining. Propodeum rugose. Abdomen with the basal segment largely punctured; second very finely and remotely, except towards the apical margin, strongly raised from the base in both sexes, its sides somewhat compressed; beneath, with the depression distinct, but shallow, rather deeper in the ♀ than in the ♂, the segment at the sides not at all strongly raised from the apices of the costae.

HAB. Molokai mountains (3000 ft.). Iao Valley, Maui, 2 ♂ not quite typical, having the apical margin of the second abdominal segment red at the sides, and below the average size of the species.

(47) *Odynerus montivagus*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus. Caput nigrum, mandibulis rufis. Pronotum rubro-notatum. Abdominis segmentum primum margine apicali late rubro; secundum utrinque rubro-maculatum. Mesonotum subnitidum, distincte punctatum. Propodeum laeve, fere impunctatum. Abdominis segmentum 2 ventrale depressione angustula. ♂♀. Long. 6—7 mm.

Black, the mandibles red. Prothorax with red markings, the rest of the thorax black. Apical margin of the basal segment of the abdomen with a wide red band, second segment with a red spot on either side.

Clypeus distinctly dentately-emarginate at the apex (but not deeply) in the ♂, less distinctly so in the ♀. Head above the antennae more or less shining, very closely and distinctly punctured. Mesothorax and scutellum not coarsely, but somewhat deeply and remotely punctured; propodeum almost smooth, slightly shining, and nearly impunctate. Basal segment of the abdomen hardly shining, with irregular shallow puncturation; second segment rather abruptly, but not very strongly, raised from the base; on its ventral surface it rises strongly and abruptly from the apices of the costae, its depression short and narrow and rather deep in front.

HAB. Molokai mountains (3000—4000 ft.). 1 ♂ 1 ♀. Iao Valley, Maui. 1 ♀.

(48) *Odynerus microdemas*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus, fronte, pronoto, mesopleuris, postscutello, lateribusque propodei rubro-notatis. Abdominis segmentum primum ex majore parte rubrum; secundum ad latera nonnunquam rubro-maculatum.

Caput supra antennas nitidum, dense punctatum. Mesonotum laeve, grosse fortiterque punctatum. Abdominis segmentum secundum minus elevatum, subtus depressione angustula. ♂ ♀. Long. 5—7 mm.

Black, the wings dark, with blue iridescence. The front of the head, the prothorax, the mesopleurae, postscutellum and sides of the propodeum have red markings. The basal segment of the abdomen is red over the greater part of its surface, and the second is sometimes spotted at the sides.

Head above the antennae closely coarsely and shallowly punctured, the apex of the clypeus hardly emarginate. Mesothorax coarsely punctured, the surface smooth between these punctures and almost (or quite) without the minute interstitial puncturation. Abdomen with the second segment not much raised from the base, shining and shallowly punctured; seen from beneath, its ventral surface is somewhat strongly raised from the costae at the sides, and even in the middle the depressed portion, where it meets these, rises up convexly from their apices; the depression itself not very wide.

HAB. Molokai mountains (3000 ft.).

(49) *Odynerus monobius*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus, fronte, pronoto, mesopleurisque rubro-maculatis; abdominis segmento primo postice interrupte rubro-marginato. Clypeus levissime dentato-emarginatus. Caput supra antennas laeve, distincte punctatum. Mesonotum subfortiter et irregulariter, propodeum in concavitate sua dense punctatum. Abdominis segmentum primum dense et grosse punctatum; secundum evidenter elevatum; subtus, ad latera minus fortiter sed abrupte supra costarum apices elevatum, depressione costis oblique occurrente. ♂. Long. 6 mm.

Male black, wings infuscate, with blue iridescence. A median spot behind the antennae, the prothorax in front, a spot on the mesopleurae, and the apical margin of the basal abdominal segment narrowly, red. Head above the antennae smooth, and somewhat largely punctured. Mesothorax irregularly punctured, the punctures closer in front and much sparser posteriorly, the surface smooth with minute interstitial puncturation visible, but by no means distinct. Propodeum with the concavity densely punctured. Basal segment of the abdomen coarsely, closely, and rugosely punctured; second evidently, but not very strongly, raised from the base; beneath, the depression shallow, the segment at the sides abruptly raised above the apices of the costae, to a height about equal to that of its basal portion.

HAB. Mountains of Molokai (3000 ft.). 1 ♂.

(50) *Odynerus rubritinctus.*

Odynerus rubritinctus, Smith, J. Linn. Soc. XIV. p. 679. Blackburn and Cameron, P. Manch. Soc. Vol. XXV. p. 155.

Odynerus sandwichensis, Dalla Torre, Cat. Hym. Fam. Vesp. (nec Saussure).

Niger, pronoto nigro, fronte, tegulis, mesopleuris, scutello saepe, postscutello et propodeo rubro-notatis; abdominis segmento primo fere toto rubro, secundi margine apicali lateribusque rubris. Caput supra antennas cum mesonoto nitidum, et grosse punctatum. Abdominis segmentum secundum convexum, vix elevatum. ♂ ♀. Long. 5—8 mm.

Black, the wings infuscate, with a blue or violaceous iridescence. The head in front, the tegulae, mesopleurae, the scutellum often, the postscutellum, and propodeum have red markings. The prothorax is black. Basal segment of the abdomen entirely or almost entirely, the apical margin of the second segment, and its sides, red. Head and thorax shining, coarsely punctured. Basal segment of the abdomen with close shallow punctures; second segment rather strongly convex longitudinally; beneath, at the sides, raised from the apices of the costae, the depression which is moderately wide meeting them obliquely.

HAB. Lanai, on the coast. Haleakala, Maui (4000 ft. or more). Not a rare species. Referred by Dalla Torre in his catalogue to *O. sandwichensis*, but probably distinct.

(51) *Odynerus potamophilus*, sp. nov.

Niger, fronte, pronoto, mesopleuris, tegulis, scutello, postscutello, et propodeo rubro-notatis. Abdominis segmentum primum fere totum rubrum; secundum margine apicali lateribusque suis rubris. Caput supra antennas cum mesonoto nitidum et fortiter punctatum. Abdominis segmentum secundum vix elevatum; subtus, depressione costarum apicibus oblique occurrente. ♀. Long. 7—8·5 mm.

Very closely allied to the preceding but readily distinguished by the red markings of the prothorax. The mesothorax in front is rather less coarsely punctured, the punctures are deeper and more distinct, being more distant. The structure of the second ventral segment of the abdomen is very similar in the two species.

HAB. Haleakala, Maui (4000—5000 ft.). Rare. 3 ♀.

(52) *Odynerus petrobius*, sp. nov.

Niger, subnitidus, alis infuscatis, caeruleo-iridescentibus. Fronte, mesopleuris, tegulis, nonnunquam scutello, postscutello, et propodeo, rubro-notatis. Segmentum abdominis primum late rubrum; secundum lateribus nonnunquam rubro-maculatis. Caput cum mesonoto grosse denseque punctatum. Segmentum abdominis secundum vix elevatum; subtus, depressione lata. ♂ ♀. Long. 5—8 mm.

Black, the wings with blue iridescence. The front of the head, the tegulae, mesopleurae, sometimes the scutellum, the postscutellum, the propodeum at the sides, the basal segment of the abdomen over a large part of its surface, and sometimes the sides of the second, have red markings. The prothorax and apical margin of the second abdominal segment are black. Clypeus truncate or very slightly emarginate at the apex; head coarsely and very closely punctured, especially in the ♂. Mesothorax with close and large puncturation, less regular posteriorly in the ♀; scutellum punctured, generally more finely in the ♀ than in the ♂. Propodeum with shallow, large punctures. Basal segment of the abdomen with coarse punctures, especially towards the base; second segment convex, hardly raised; beneath with the depression wide and rather deep, the segment at the sides being raised from the apices of the costae to a height equal to, or rather greater than, that of its basal portion.

HAB. Molokai coast, and in the mountains as high as 3000 ft.

(53) *Odynerus rubropustulatus*.

Odynerus rubropustulatus, Blackburn, P. Manch. Soc. Vol. xxv., Session 1885—1886, p. 159.

Niger, rubro-notatus, alis infuscatis caeruleo-iridescentibus, praecedenti simillimus, mesonoto minus dense punctato, thorace toto cum propodeo nigro bene distinguendus. ♂ ♀. Long. 6—8 mm.

Very closely allied to the preceding, the wings with a similar bright blue iridescence. The thorax is rather less shining between the punctures, which are less strong; and the propodeum as well as the rest of the thorax is entirely black, without red markings. The depression beyond the costae of the second ventral segment is also of a somewhat different character, and less deep.

Hab. Mountains of Hawaii (4000 ft.), Kona and Kau districts.

(54) *Odynerus blackburni.*

Odynerus blackburni, Kirby, Ent. Month. Mag. xvii. p. 87. Blackburn, P. Manch. Soc. Vol. xxv. No. 8, Session 1885—1886, p. 156.

Odynerus rubritinctus, Smith ♂ nec ♀. J. Linn. Soc. Vol. xiv. p. 674.

Niger, alis fuscis, subaeneo- vel violaceo-micantibus, fronte, tegulis, mesopleuris, scutello plus minusve, postscutello, et propodeo rubro-notatis. Abdominis segmentum primum ex majore parte rubrum; secundum maculis lateralibus rubris. Coxis femoribusque saepe plus minusve rufis. ♂ ♀. Long. 6—9 mm.

Form and sculpture much as in the two preceding species, with which it agrees also in having the prothorax and apical margin of the second abdominal segment black. The scutellum is always spotted with red, sometimes almost entirely of that colour, and the second segment of the abdomen has large lateral red spots. The propodeum is largely red. The head, thorax, and basal segment of the abdomen are covered with large and close punctures; the second segment longitudinally convex, but not evidently raised from the base. The wings are dark with somewhat of a brassy glitter, and in some specimens with more or less violaceous iridescence, but not blue.

Hab. Kauai coast and lower slopes of the mountains. Abundant.

(55) *Odynerus soror*, sp. nov.

O. blackburni simillimus, sed pronoto anguste rufo-lineato, mesonoto magis nitido, postice magis profunde punctato, abdominis segmento secundo fortius convexo distinguendus. ♀. Long. 8 mm.

Very like *O. blackburni*, the wings of the same colour, without any bright blue iridescence. The prothorax in front has a narrow red line on each side, the whole thorax is more shining, the puncturation of the mesothorax is deeper and clearer posteriorly; the second segment of the abdomen is rather more strongly convex longitudinally, and beneath, its depression is rather deeper.

Hab. Mountains of Kauai in the forest (3000 ft.); 2 ♀ taken.

(56) *Odynerus frater*, D. T.

Odynerus frater, Dalla Torre, Cat. Hym. Fam. Vespidae.
Odynerus pacificus, Blackburn, P. Manch. Soc. Vol. xxv. (1885—1886), p. 159; (nec Kirsch).

Niger, opacus, alis obscure caeruleo-iridescentibus, abdominis segmento primo et secundo totis, vel fere totis, rufis. Clypeus emarginatus. Caput cum mesonoto peropacum, subobsolete punctatum. Abdominis segmentum secundum haud quaquam elevatum; subtus, depressione lata. Thorax cum propodeo totus niger, tegulis nonnunquam rufis. ♂ ♀. Long. 5·5—8 mm.

Black, the wings infuscate and with slight blue iridescence. Two basal segments of the abdomen nearly entirely red. Clypeus distinctly emarginate, head and thorax with the surface very dull, and the punctures feebly impressed, more nearly obsolete in some examples than in others. Abdomen with the basal segment dull, closely, but very shallowly, punctured; second slightly shining, simply convex longitudinally; beneath, with the depression well-defined, meeting the apices of the costae widely at its base.

Hab. Hawaii, on the coast. Molokai and Maui coast, and lower slopes of the mountains. On the latter two islands this species has the tegulae red; those from Hawaii have these parts black.

(57) *Odynerus obscure-punctatus*.

Odynerus obscure-punctatus, Blackburn, l. c. p. 160.

Niger, alis infuscatis, laete caeruleo-iridescentibus, thorace cum propodeo nigro, abdominis segmentis 2 basalibus maculis rubris lateralibus ornatis. Caput supra antennas subobsolete punctatum. Mesonotum peropacum, plus minusve obscure et subobsolete punctatum, propodei puncturatione fere obsoleta. Abdominis segmentum primum aequaliter punctatum, segmenti 2 ventralis depressione lata, costarum apicibus late occurrente. Long. ♂ 6—8, ♀ 8—9 mm. (Plate I. fig. 13.)

Black, wings infuscate, and with bright blue iridescence. Mandibles more or less red. Thorax and propodeum without red markings. Two basal segments of the abdomen with red lateral spots. Clypeus very slightly emarginate or truncate; head above the antennae with very feebly impressed puncturation. Thorax very dull, with very shallow more or less obsolete punctures. Propodeum with indications of large, shallow puncturation. Abdomen shining, basal segment evenly punctured;

second more finely so, somewhat strongly convex at the base in the ♂, less strongly in the ♀; beneath with a well-marked deep depression, meeting the apices of the costae widely at its base.

HAB. Kona district of Hawaii, on the coast, and in the mountains up to an elevation of 3000 ft. or more. Oahu? Beechey expedition. In the British Museum.

(58) *Odynerus dyserythrias*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus, abdominis segmento secundo subtus rubro, nonnunquam lateribus ejus rubro-maculatis; mandibulis rufis. Clypeus distincte dentato-emarginatus. Caput supra antennas confertissime, mesonotum dense fortiterque punctatum. Propodeum rugosum. Abdominis segmentum 2 ventrale depressione angustula, minus alta. ♂. Long. 8 mm.

Male black, the abdomen entirely black above, or with a red spot at the sides of the second segment, which beneath is nearly entirely red. Mandibles red, the clypeus distinctly dentately-emarginate; head above the antennae very densely punctured; mesothorax deeply and closely (more densely in some examples than in others), the interstices between these punctures somewhat shining and minutely punctured; scutellum very distinctly punctured, but more finely than the mesothorax; propodeum rugose. Abdomen with the basal segment closely and evenly punctured; second segment beneath raised at the sides above the apices of the costae to about the height of its basal portion, the depression feeble, with a more deeply impressed median line.

HAB. Kilauea, Hawaii (4000 ft.). Eight or nine ♂ taken, but no ♀.

(59) *Odynerus cyanopteryx*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus, mandibulis cum apice clypei rufis, abdominis segmenti secundi lateribus rubro-maculatis. Mesonotum opacum, subtilius, sat distincte punctatum. Abdominis segmentum secundum juxta basim subelevatum; subtus, costis brevissimis, depressione levissima et angustissima. ♂ ♀. Long. 7—9 mm. (Plate I. fig. 28 and 28 *a*.)

Black, the wings with bright blue iridescence, the thorax entirely black, as also the basal segment of the abdomen. Mandibles and apex of clypeus red. Second segment of the abdomen with a red spot at the sides in front, and more or less red on its ventral surface. In one example these markings are very obscure, but they can be seen in a favourable light. Apex of clypeus very slightly dentately-emarginate; the head above the antennae dull, and shallowly punctured. Mesonotum not coarsely, but quite distinctly punctured, the surface dull. Abdomen with the surface shining, the basal segment depressed along its apical margin, with shallow puncturation; second segment evidently raised from its base, especially in the ♂; beneath with the costae very short, the depression narrow and very light, sometimes hardly evident.

HAB. Kona and Kau districts of Hawaii (4000 ft.).

(60) *Odynerus egens*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus, mandibulis et apice clypei rubris, abdomine toto nigro. Caput cum mesonoto peropacum, vix evidenter punctatum. Abdominis segmentum 2 ventrale costis fortibus et brevissimis, post has subplanum, depressione nulla. Long. ♂ 8 mm.

Black, the wings with blue iridescence, the apex of the clypeus and the mandibles red. Thorax and abdomen black. On the second ventral segment of the latter a faint reddish tint can be seen in a strong light. Head and thorax with the surface finely roughened, dull, the puncturation almost obsolete. With a very strong lens both systems of the thoracic punctures can be seen to be present, but very feebly impressed; the minute ones are rather less nearly obsolete, and form the chief part of the puncturation. The mesothorax in front has a smooth median line, extending back about one-third of its whole length. The second segment of the abdomen is very little raised from the base; beneath, the costae are short but strong, not so long as the basal part of the segment, which is shining; beyond the costae there is no evident depression, but the surface is nearly flat.

HAB. Kona, Hawaii (4000 ft.), Aug. 19, 1892, 1 ♂.

(61) *Odynerus nesiotes*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus, abdominis segmentorum 2 basalium marginibus postice albo-marginatis. Mesonotum subnitidum grosse, fortiter, denseque punctatum. Abdominis segmentum 2 ventrale sulco nitido, costis fere obsoletis, depressione lineari, minus distincta. ♂ ♀. Long. 7·5—9 mm.

Black, the wings with blue iridescence. Basal segment of the abdomen with a narrow, and the second with a wide, cream-coloured apical band. Head above the antennae, and the mesothorax, very densely, coarsely and rugosely punctured, the surface between the punctures shining. Propodeum with evident but shallow puncturation. Abdomen with the basal segment densely punctured; second segment beneath, with the sulcature for the most part smooth, with only traces of the costae at its base, the depression represented by a faintly impressed line.

HAB. Mountains of Kauai, near Makaweli (2000—3000 ft.).

(62) *Odynerus dubiosus.*

Odynerus dubiosus, Smith, Proc. Linn. Soc. XIV. p. 681. Blackburn and Cameron, l. c. p. 155.

Niger, alis fuscis, haud caeruleo-iridescentibus. Mesonotum vix nitidum, ♂ subgrosse, ♀ subtilius punctatum. Abdominis segmentum primum juxta basim grosse punctatum; secundum longitudinaliter convexum, vix elevatum; subtus, depressione distincta, sat lata. ♂♀. Long. 6—8 mm.

Black, the wings shining fuscous, without blue iridescence. Apex of clypeus depressed, hardly emarginate, head above the antennae with close and very shallow punctures. Mesothorax with the surface very slightly shining, somewhat coarsely punctured, but not deeply. Propodeum with very shallow punctures, giving it a more or less rugose appearance. Basal segment of the abdomen coarsely punctured at the base, the punctures becoming finer towards the apex; second segment hardly raised from the base, but longitudinally convex; beneath, with a very distinct depression, which is wide in front.

HAB. Honolulu, Waianae, &c., Oahu; on the plains. Very abundant round walls built of lava, in the holes of which it forms its cells.

(63) *Odynerus threnodes*, sp. nov.

Niger, opacus, alis fuscis, subaeneo-micantibus. Clypeus vix emarginatus. Mesonotum opacum, crebre, aequaliter, nec grosse, punctatum. Abdominis segmentum secundum minus elevatum; subtus, depressione lata, sat alta, costis oblique occurrente. ♀. Long. 6·5—8 mm.

Female black, with the wings shining fuscous and with a slight bronzy tint in certain aspects. Mandibles black, reddish at the tips; clypeus depressed at the apex, hardly emarginate; head above the antennae dull, with close but shallow punctures. Mesothorax dull, for the most part evenly and rather finely punctured; propodeum with the surface finely rugulose, the puncturation nearly obsolete. Basal segment of the abdomen in dorsal view about as long as wide, closely and shallowly punctured, the punctures coarser than those of the mesothorax; second segment scarcely raised from the base, hardly more than ordinarily convex; its sides beneath rather strongly raised from the apices of the costae, attaining a height evidently greater than that of the basal portion of the segment, the depression somewhat wide and deep, meeting the apices of the costae obliquely.

HAB. Waianae Mountains, Oahu (2000 ft. or more). 2 ♀.

This species is very closely allied to the preceding, but may be distinguished by the more shining mandibles, the duller surface of the mesothorax, which is more finely and rather more deeply punctured, and by the deeper depression of the second ventral segment of the abdomen.

(64) *Odynerus pterophaennes*, sp. nov.

Niger, nitidus, alis fuscis, micantibus, clypei apice truncato. Mesonotum nitidum sparsim irregulariter punctatum; propodeum laeve, haud dense punctatum. Abdominis segmentum secundum subfortiter elevatum, nitidum, puncturatione fere obsoleta; subtus, depressione minus lata. ♀. Long. 7·5 mm.

Female black, shining; wings fuscous, darker along the costal margin. Clypeus truncate at the apex, head above the antennae smooth and shining, with shallow punctures. Mesothorax shining, with fine sparse and irregular puncturation, propodeum smooth, but less shining than the rest of the thorax, with evident, but shallow, punctures. Abdomen shining, nearly vertical in front, coarsely punctured at the base, the punctures decreasing in size towards the apex; second segment rather abruptly raised from the base, with very fine indistinct punctures, even to the apical margin; beneath, with the depression narrow and not deep.

Hab. Oahu, a single ♀ taken in March, 1893, on the coast at Waialua, and a second in the Waianae Mountains (2000 ft.) in February, 1896.

(65) *Odynerus iopteryx*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus. Clypeus apice truncato; mesonotum subnitidum, sparsim subtiliter punctatum; propodeum opacum et rugosum. Abdominis segmentum primum juxta basim grosse, secundum vel ad apicem vix punctatum. ♀. Long. 7 mm.

Female black, the wings infuscate and with blue iridescence. Clypeus truncate at the apex; head above the antennae shining, with close and very shallow punctures. Mesothorax not very shining, finely and sparsely punctured, and with a distinct, but extremely fine, interstitial puncturation; scutellum with a few very feeble fine punctures; propodeum dull and rugose. Basal segment of the abdomen with very coarse shallow punctures at the base, less coarse towards the apex; second segment very strongly convex longitudinally from the base, its surface shining and without a definite puncturation, although in certain aspects traces of nearly obsolete punctures can be discerned; beneath, at the sides, it is raised from the apices of the costae to about the height of its basal portion, the depression shallow.

Hab. A single ♀ taken in the Waianae Mountains, Oahu, in April, 1892, at an elevation of over 2000 ft.

(66) *Odynerus waianaeanus*, sp. nov.

Niger, alis nitide fuscis, haud caeruleo-iridescentibus, abdominis segmento primo postice flavo-marginato. Clypeus leviter dentato-emarginatus. Mesonotum minus nitidum, subfortiter punctatum. Abdominis segmentum 2 ventrale depressione angustissima, haud alta. ♂. Long. 7 mm.

Male black, the wings fuscous, iridescent, but not blue; basal segment of the abdomen narrowly pale along its posterior margin. Clypeus slightly dentately-emarginate at the apex, head above the antennae closely punctured. Mesothorax slightly shining, somewhat coarsely and closely punctured. Propodeum with the surface somewhat smooth and bearing some large and very shallow punctures. Basal segment of the abdomen as long as wide in dorsal aspect, depressed along the apical margin, with shallow irregular punctures. Second evidently raised from the base; beneath with the depression very shallow and narrow.

Hab. Waianae, Oahu, on the coast. 1 ♂ taken.

(67) *Odynerus flosculus*, sp. nov.

Praecedenti simillimus, abdominis segmentis duobus basalibus postice albo-marginatis. ♂. Long. 7 mm.

Very like the preceding, of which it may possibly be a variety. It differs in having a rather wide yellowish-white apical band on the second segment of the abdomen, which is continued on the ventral surface. The mesothorax posteriorly is rather more rugosely punctate, and the depression of the second ventral segment is more definite, with a well-marked impressed median line.

Hab. Waianae, Oahu, on the coast; 1 ♂ taken.

(68) *Odynerus cooki*, sp. nov.

Niger, alis fuscis, nitentibus, iridescentibus, haud caeruleis; abdominis segmentis duobus basalibus postice flavo-marginatis. Mesonotum opacum, subtilius punctatum. Abdominis segmentum secundum longitudinaliter convexum; subtus, costis validis, depressione nulla. ♂. Long. 5—6 mm.

Male black, the wings shining, fuscous, iridescent, but not blue. Apical margin of each of the two basal abdominal segments narrowly yellowish-white. A minute median spot behind the insertion of the antennae, and one behind each eye of the same colour. Clypeus slightly dentately-emarginate. Head above the antennae with obscure, ill-defined punctures. Mesothorax dull, somewhat finely and not closely punctured, the punctures shallow. Propodeum dull, with the posterior concavity rugose. Basal segment of the abdomen transverse in dorsal aspect, with shallow punctures; second simply convex longitudinally above; beneath with the costae strong, followed by a smooth space in the part usually occupied by a depression, which in this species is wanting, the segment being nearly flat beyond the costae and not elevated even at the sides.

HAB. Kealakeakua bay, Hawaii; ♂ only taken, close to the monument erected to Captain Cook.

(69) *Odynerus acœlogaster*, sp. nov.

Niger, alis infuscatis, subcaeruleo-iridescentibus, clypeo, fronte, tegulis, postscutello, tibiisque flavo-notatis, abdominis segmentis duobus basalibus postice flavo-marginatis. Clypeus apice truncato. Mesonotum vix nitidum, distincte, sed postice minus aequaliter, punctatum. Abdominis segmentum 2 ventrale costis parte sua basali brevioribus, post has subplanum, depressione obsoleta. ♂. Long. 7·5 mm.

Male black, the clypeus, a median spot behind the antennae, one on the tegulae, the postscutellum, the tibiae more or less above, and the hind margin of the two basal abdominal segments, pale yellow. Wings infuscate and with a blue iridescence. Apex of clypeus truncate. Mesothorax slightly shining, distinctly and rather finely punctured, more sparsely posteriorly than in front. Propodeum dull, somewhat finely rugose. Basal segment of the abdomen with shallow punctures; second somewhat raised from the base; beneath, with the costae short, shorter than the basal portion of the segment, which is tumid; beyond the costae the segment is nearly flat, and without any definite depression.

HAB. Waianae, near sea-level; 1 ♂ taken. The markings would probably vary in a series, but the species is very distinct structurally.

(70) *Odynerus vittativentris*, sp. nov.

Niger, alis infuscatis caeruleo-iridescentibus, abdominis segmentis duobus basalibus postice albo-marginatis. Mesonotum dense distincteque nec grosse punctatum. Propodeum sublaeve, vix evidenter punctatum. Abdominis segmentum 2 ventrale costis brevissimis, sat fortibus, parte sua basali tumida, post costas depressione nulla. ♂♀. Long. 8—10 mm. (Plate I. fig. 29 and 29*a*.)

Black, the wings infuscate, and with blue iridescence, the two basal segments of the abdomen with yellowish-white apical bands, that on the second the wider. Clypeus slightly dentately-emarginate in the ♂, truncate or nearly so in the ♀.

Mesothorax dull in the ♂, generally somewhat shining in the ♀, distinctly and closely, but not coarsely, punctured. Propodeum somewhat smooth, with very obscure traces of puncturation. Basal segment of the abdomen finely and not very closely punctured; second hardly raised from the base; beneath, with the costae very short, although rather strong, much shorter than the tumid and strongly developed basal portion of the segment, beyond the costae somewhat flat, and with no evident depression.

HAB. Mountains of Kauai; not rare.

(71) *Odynerus cephalostictus*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus, fronte flavo-notata, abdominis segmento primo rufescente, secundi lateribus rufo-maculatis. Clypeus fortiter emarginatus. Mesonotum minus nitidum, inaequaliter subtiliterque punctatum. Propodeum opacum subobsolete rugoso-punctatum. Abdominis segmentum 2 ventrale depressione levissima, male definita. ♀. Long. 9—9·5 mm.

Female black, with a small median flavous spot behind the antennae, the basal segment of the abdomen mostly red, the second red at the sides near the base. Wings infuscate and with blue iridescence. Apex of clypeus deeply emarginate; head above the antennae not very densely punctured. Mesothorax somewhat shining, with fine shallow and irregular puncturation; between these punctures the surface is very densely and minutely punctured. Propodeum dull, with rugose and almost obsolete puncturation. Basal segment of the abdomen vertical in front, and shallowly punctured; second slightly raised from the base; beneath, with the depression very shallow and more or less vague, the segment even at the sides hardly raised from the apices of the costae.

HAB. Mountains of Molokai; rare, 3 ♀ taken between June and September, 1893, at an elevation of 3000 ft.

(72) *Odynerus axestes*, sp. nov.

Niger, fronte flavo-notata, mandibulis plus minusve rufis, abdominis segmento primo et secundo lateribus obscure rufescentibus, alis infuscatis, caeruleo-iridescentibus. Clypeus fortiter emarginatus. Mesonotum peropacum, inaequaliter leviter punctatum, propodei concavitate rugosa. Abdominis segmentum secundum longitudinaliter convexum, subtus depressione levissima. ♂. Long. 9 mm.

Black, with a median flavous spot behind the antennae, the mandibles more or less red, and the two basal segments of the abdomen obscurely reddish at the sides, the second for the most part red also beneath. Wings infuscate, with a blue iridescence. Clypeus deeply emarginate, the head above the antennae dull, and with very shallow punctures. Mesothorax with the surface very dull, the puncturation irregular, very feebly impressed, and somewhat fine, the interstices with minute puncturation which is also very feebly impressed. Propodeum dull, the surface finely roughened, the concavity somewhat rugose. Abdomen with the second segment longitudinally convex, not otherwise raised from the base; beneath, with the depression evident, but very shallow.

HAB. Kona district, Hawaii, 4000 ft. Rare, 2 ♂ taken; June and September, 1892. Closely allied to the preceding but easily known by the very dull mesothorax, the less raised (or tuberculate) second dorsal segment of the abdomen, &c.

(73) *Odynerus insulicola.*

Odynerus insulicola, Blackburn, P. Manch. Soc. Vol. XXV. (1885–86), p. 163.
Odynerus nautarum, Dalla Torre, Cat. Hym. Fam. Vesp., nec de Saussure.

Niger; haud nitidus, alis infuscatis, plus minusve caeruleo-iridescentibus. ♂ clypeo, antennarum articulo basali, tegulis, postscutello, nonnunquam pronoto, tibiisque, flavo-notatis; abdominis segmentis 2 basalibus postice flavo-marginatis. Colore variabilis, sed clypeo semper plus minusve flavo-notato; ♀ nigra, abdominis segmento primo nonnunquam postice pallido-marginato. Clypeus fortius emarginatus. Frons capitis remote, mesonotum inaequaliter, subtiliter punctatum. Abdominis segmentum secundum haud elevatum; subtus, depressione distincta, minus alta. ♂♀. Long. 7—9 mm.

Male with the clypeus almost entirely, or only a small spot on it, yellow. The scape of the antennae, the tegulae, the apical margins of the first two abdominal segments, the tibiae, and sometimes the prothorax and postscutellum have yellow markings. Excepting that the clypeus has always (as it appears) at least a yellow spot, all these markings may be wanting, and some of them at least, generally are. Female black, with a minute spot behind the eyes, and sometimes the apical margin of the basal segment of the abdomen pale.

Clypeus distinctly, and usually somewhat angulately emarginate in both sexes; head above the antennae finely and remotely punctured. Mesothorax dull, finely and irregularly punctured, the puncturation finer in the ♀ than in the ♂. Propodeum subobsoletely and somewhat rugosely punctured. Basal segment of the abdomen with shallow, more or less even punctures; second not raised from the base, covered in fresh examples with fine sericeous pubescence; beneath with the depression rather wide, but shallow, meeting the apices of the costae obliquely.

HAB. Molokai, Lanai, and Maui, on the coast, and in open country up to an elevation of 3000 ft., but not in the forest. Dalla Torre in his catalogue refers this species to *O. nautarum*, Sauss., but that species has 'le métathorax seul ponctué.'

(74) *Odynerus nesotrephes*, sp. nov.

Niger, alis infuscatis, subcaeruleo-iridescentibus, tegulis cum postscutello flavo-notatis, abdominis duobus segmentis basalibus postice flavo-marginatis. Clypeus distincte emarginatus. Mesonotum opacum, subtiliter et inaequaliter punctatum, interstitiis densissime et minutissime ruguloso-punctatis. Propodeum subobsolete punctatum, concavitate rugosa. Abdominis segmentum 2 ventrale depressione lata, minus alta. ♀. Long. 8 mm.

Female black, with the tegulae and postscutellum spotted with yellow, and the hind margin of the two basal abdominal segments of the same colour. Wings infuscate with very little blue iridescence. Clypeus distinctly emarginate, head above the antennae dull with somewhat remote and fine puncturation. Mesothorax dull, finely and irregularly punctured, more sparsely behind than on the anterior part. Propodeum with some large shallow punctures in front, the concavity rugose. Abdomen dull, covered with sericeous pubescence, the second segment not raised, ordinarily convex longitudinally; beneath with a well-marked, wide, but shallow depression, costae longer than the basal part of the segment, strong, but not very closely set.

Hab. Waialua, Oahu, a single example on the coast.

(75) *Odynerus lanaiensis*, sp. nov.

Niger, alis plus minusve infuscatis et caeruleo-iridescentibus. Clypeus vix emarginatus. Mesonotum dense fortiter punctatum. Propodeum opacum rugoso-punctatum. Abdominis segmentum secundum vix elevatum; subtus, depressione distincta nulla. ♂♀. Long. 6·5—10 mm.

Black, the wings infuscate, but not deeply, except along the costal margin of the anterior pair, their iridescence blue.

Apex of the clypeus hardly emarginate, head above the antennae densely punctured. Mesothorax strongly and closely punctured, the punctures rather larger in the ♂, and the surface of the thorax more dull. Propodeum rugose. Basal segment of the abdomen somewhat evenly punctured; second slightly raised from the base; beneath, somewhat flat beyond the costae, with no depression, or at the most with only a vague indication of one.

Hab. Lanai, on the coast at Manele.

(76) *Odynerus pterocheiloides*, sp. nov.

Niger, alis infuscatis, caeruleo-iridescentibus, fronte ♂ flavo-notata, mandibulis rufis. Caput cum mesonoto ♂ opacum, ♀ vix nitidum; mesonotum ♂ minus dense, ♀ sparsim subtiliter punctatum. Propodeum puncturatione fere obsoleta subrugosum. Abdominis segmentum secundum haud elevatum, subtus depressione fere obsoleta. ♀ palpi labiales pilis longis utrinque ciliati. Long. ♂ 5—7·5, ♀ 9 mm.

Black, the wings infuscate, and with blue iridescence, the ♂ with a median flavous spot behind the antennae.

Head and mesothorax dull in the ♂, and hardly shining in the ♀. Mesothorax finely, feebly, and sparsely punctured in the ♀, rather more largely and closely in the ♂, but very shallowly. Minute puncturation between these punctures distinct. Propodeum somewhat rugose, with nearly obsolete punctures. Abdomen with the second segment convex but not raised from the base; beneath, with the depression nearly obsolete. Labial palpi of the ♀ extremely long, and beautifully ciliated with long hairs. Mandibles more or less red or reddish.

Hab. Kona district of Hawaii (4000 ft.). Hawaii (loc. ?), Blackburn. Mr Blackburn has sent over a ♀ of this species, as representing his *O. hawaiiensis*, but it does not at all agree with his description of that species.

(77) *Odynerus congruus*.

Odynerus congruus, Smith, J. Linn. Soc. xiv. p. 680. Blackburn and Cameron, P. Manch. Soc. xxv. p. 155.

Praecedenti forma et magnitudine similis, capite et mesonoto magis nitidis et laevioribus distinguendus. ♂♀. Long. 6—10 mm. (Plate I. fig. 30.)

Very closely allied to the preceding, but easily distinguished by the more shining surface of the front of the head and the mesothorax. In the ♀ the second ventral segment has no depression beyond the costae, and behind the antennae there is a median flavous spot as in the ♂.

Hab. Molokai, Lanai, and Maui, on the coast, and in the mountains, up to an elevation of 3000 ft., but not in the forest. This and the closely allied preceding species are, as far as the ♀ is concerned, very different to any other Hawaiian species. The type of the ♂ has four yellow spots on the clypeus, which is abnormal, the clypeus usually being entirely black. It is remarkable that the extraordinary appearance of the palpi has been passed over unnoticed. The locality 'Honolulu' is given in Lit. and Phil. Soc. Manch. Vol. xxv. (1885–86), p. 155, but this is no doubt an error, as in Ent. Mo. Mag. Vol. xvii. p. 87, the species is said to have been taken with *Prosopis blackburni*, an insect peculiar to Maui, and I have myself taken them together on that island.

(78) *Odynerus chelifer*, sp. nov.

Niger, alis infuscatis caeruleo-iridescentibus, mandibulis plus minusve rufescentibus vel piceis. Mesonotum opacum, distincte subtilius punctatum. Abdominis segmentum secundum haud elevatum; subtus, depressione fere obsoleta. Uterque sexus genis inter oculos mandibulasque distinctis (♀-ae longioribus) insignis. Mandibulae (♀) perlongae et angustae, dentibus fere obsoletis. ♂♀. Long. 5—7 mm. (Plate I. fig. 31.)

Black, the wings infuscate, and with blue iridescence. Mandibles more or less red or piceous on their apical portion. The cheeks between the base of the mandibles and eyes are distinct in both sexes, but longer in the ♀, in which sex the mandibles are extremely long and narrow, with the teeth obsolete or nearly so. The length of the part of the mandible, which projects beyond the apex of the clypeus, is about equal to the length of the clypeus itself. Interantennal carina very distinct and sharp, no flavous spot at its base. Mesothorax dull, distinctly but finely punctured; propodeum roughened by the subobsolete punctures. Abdomen with the second segment simple above, not raised from the base; beneath, with the depression extremely feeble and indefinite.

HAB. Kona, Hawaii (4000 ft.); Molokai and Lanai (coast to 3000 ft.). Rare. The examples from Hawaii do not altogether agree with the others, but the material is insufficient to separate them specifically.

(79) *Odynerus nigripennis*.

Rhygchium nigripennis, Holmgren, Eugenies Resa, Zool. VI. p. 441.
Odynerus maurus, Smith, J. Linn. Soc. XIV. p. 679.
Odynerus nigripennis, Blackburn and Cameron, P. Manch. Soc. Vol. XXV. (1885—86), p. 151.

Niger, robustus, alis infuscatis, caeruleo-iridescentibus, fronte flavo-notata. Clypeus leviter dentato-emarginatus. Mesonotum cum scutello densissime, subtilius, rugoso-punctatum. Postscutellum ad truncationem linea elevata (plerumque serrulata) munitum. Abdominis segmentum secundum haud elevatum; subtus, depressione lata, minus alta, costis subobsoletis. Long. ♂ 7—10·5 mm. ♀ 8—14 mm.

Black, the wings infuscate, and with a blue (but not bright) iridescence. A small median spot behind the antennae, and another behind each eye, often flavous. Apex of clypeus depressed, and lightly emarginate. Mesothorax finely, but very densely rugosely-punctate, the punctures generally rather larger in the ♂. Postscutellum with a very distinct raised line (usually serrulate or spinulose) at the truncation. Propodeum rough with large, feebly impressed, punctures. Abdomen with the second segment not raised from the base; beneath, with a wide depression, but shallow, meeting the apices of the costae obliquely, the costae themselves more or less obsolete or indistinct.

HAB. All over the islands from Oahu to Hawaii on the coast and as high as 4000 ft. in the mountains.

(80) *Odynerus radula.*

Odynerus radula, Fab. Ent. Syst. II. p. 269. Blackburn and Cameron, l.c. p. 150.

Odynerus localis, Smith, J. Linn. Soc. XIV. p. 678. (♂ nec ♀.)

Praecedenti cognatus, niger, robustus, alis infuscatis, caeruleo-iridescentibus, abdominis segmentis 2 basalibus postice flavo-marginatis. Mesonotum dense rugoso-punctatum; propodeum rugosum. Abdominis segmentum secundum haud elevatum; subtus, depressione latissima, oblique costis occurrente. Long. ♂ 6·5—11, ♀ 9—14 mm. (Plate I. fig. 14.)

Black, the wings infuscate and with blue iridescence, the apical margins of the two basal abdominal segments yellow. Of the same robust form as the preceding, and like that species with transverse basal segment of the abdomen, and a raised line at the truncation of the postscutellum. On the mesothorax two forms of puncturation can be made out in the ♂, consisting of larger and smaller punctures, the whole forming a dense and subrugose puncturation. In the ♀ the mesothoracic puncturation is almost identical with that of the preceding. The depression of the second ventral segment is wide and shallow, the costae are less obsolete than those of *O. nigripennis*.

HAB. Kauai, common on the coast and in the mountains, occupying the place which *O. nigripennis* holds on the other islands. It is evidently a directly modified form of that species.

(81) *Odynerus localis*, Smith.

Odynerus localis, Smith, J. Linn. Soc. XIV. p. 678. (♀ nec ♂.)

Niger, alis infuscatis, caeruleo-iridescentibus, abdominis segmentis 2 basalibus postice albo-marginatis. Mesonotum ♂ dense rugoso-punctatum, ♀ creberrime subtilius punctatum. Postscutellum linea elevata munitum. Abdominis segmentum primum subdepressum, parte anteriore dorsali parti subacute occurrente; secundum haud elevatum; subtus depressione minus lata. ♂♀. Long. 8—17 mm. (Plate I. fig. 15.)

Allied to the preceding species, but with the abdominal bands wider. The scutellum is more rugosely punctured, and the basal segment of the abdomen is differently formed, being somewhat depressed from the base to the apex, and where the anterior and dorsal surfaces meet a comparatively sharp edge is formed, instead of this part being evenly rounded off. The depression of the second ventral segment is much less wide at its base, occupying only about the middle third of the segment, and the middle costa of the series is conspicuously long. The abdomen is altogether more shining, as also the surface of the mesothorax of the ♀.

Hab. Mountains of Kauai. Not rare.

The following five species of the genus *Odynerus* were brought back by the Beechey expedition many years ago. Probably all were collected at or near Honolulu, and most if not all of them are in that case now extinct. Neither the Rev. T. Blackburn nor myself have met with any of these species. The descriptions of the first two are copied from de Saussure's Etud. Fam. Vesp. (Pt. III.). The types were originally in the British Museum, but apparently no longer exist. A single insect in that collection was assigned to *O. nautarum*, de Sauss. but does not agree with the description. Under the name *O. sandwichensis*, de Sauss. (or rather *sandwithii!*), were placed several insects of three quite distinct species, none of which could possibly have been the subject of de Saussure's description.

"Etud. d. Fam. Vesp. (Pt. III.). Mon. Masar. et Suppl. p. 289. Div. *Antodynerus*."

(82) "*O. nautarum*, n. sp."

"*Niger signaturis flavis: abdominis fasciis duabus flavis.*"

"Long. 9 mm.; env. 18 mm."

"Mâle. Formes allongées de l'*O. punctum*. Métathorax arrondi, lisse au milieu. Chaperon bituberculé au bout. Insecte noir, lisse; le métathorax seul ponctué. Chaperon, un point au haut des mandibules, devant du premier article des antennes, jaunes. Deux taches sur le prothorax, écaille, un tache sur l'aile, postécusson et une bande interrompue sur l'écusson, jaunes. Les deux premiers segments de l'abdomen ornés d'un large bordure jaune. Pattes noires; les tibias seuls, jaunes d'un côté; tarses noirs. Ailes hyalines, la côte enfumée, et le bout un peu violet.

Var. Ecailles, écusson, et antennes noires.

Habite: Les îles Sandwich. (Musée de Londres.)"

(83) "*O. sandwichensis*, n. sp."

"*Parvulus, niger, perdepressus; postscutello, metathorace, abdominis primo segmento, secundi margine et lateribus, rubris; alis caerulescentibus.*"

"Long. 7 mm.; env. 15 mm."

"Mâle. Petit, grêle, *très déprimé.* Métathorax dépassant de beaucoup le post-écusson, arrondi. Abdomen très plat; le premier segment en cloche, moins large que le deuxième. Insecte noir, ponctué, mais lisse et luisant. Entre les antennes un point rouge; un autre sous l'aile; deux autres sur chaque écaille; postécusson et métathorax d'un rouge sombre; le premier segment de l'abdomen, le bord du deuxième et ses côtés, de la même couleur, ainsi qu'un fin liseré le long des autres segments. Pattes noires. Ailes assez brunes, avec un reflet violet; deuxième cubitale subtriangulaire.

Distinct par sa forme très aplatie.

Habite. Les îles Sandwich. (Musée de Londres.)"

OBS. This species is evidently closely allied to *O. rubritinctus*, Sm.

The three following species are in the collection of the British Museum, and each is represented by only a single example. They appear to be distinct from any of the species collected by me.

(84) *Odynerus infaustus*, sp. nov.

Niger, mandibulis clypeique parte apicali rubris. Caput cum mesonoto obsolete punctatum. Abdominis segmentum secundum ventrale haud post costas depressum, parte basali permagna, costis multo longiore. ♀.

Black, mandibles and apical half of the clypeus red, the latter faintly emarginate at the apex. Head and whole thorax dull, the puncturation obsolete. Abdomen with the punctures of the basal segment very feebly impressed. Second ventral segment beneath with the basal portion very large, several times as long as the short costae, beyond which there is no depression. Wings dark, with violet iridescence.

HAB. Brought back by the Beechey expedition, probably from Oahu. The species appears to be very closely allied to *O. egens*, next to which it may be placed.

(85) *Odynerus oblitus*, sp. nov.

Niger, alis fuscis, abdominis segmentum basale postice testaceo-marginatum. Mesonotum opacum subtiliter sparsim punctatum, necnon etiam interstitiis subtilissime distincte punctulatis. Abdominis segmentum secundum ventrale post costas haud depressum, costis fortibus. ♂.

Black, the wings fuscous without blue iridescence, the apical margin of the basal segment of the abdomen testaceous, perhaps yellow in fresh examples. Clypeus faintly emarginate at the apex. Head dull, finely, feebly, and irregularly punctured. Mesothorax dull, very finely and sparsely punctured, and with a distinct and very minute puncturation between the larger punctures. Propodeum dull impunctate. Basal segment of the abdomen obsoletely punctured; second, beneath, with strong costae and beyond their apices flat, with no depression.

Hab. Brought back by the Beechey expedition, probably from Oahu. A single much mutilated ♂ example in the British Museum.

(86) *Odynerus relictus*, sp. nov.

Niger, capite cum thorace flavo-notato. Abdominis segmenta duo basalia postice flavo-marginata. Mesonotum opacum, sat evidenter, subirregulariter, punctatum. Abdominis segmentum primum leviter punctatum; secundum ventrale post costas haud depressum, costis distinctis, parte sua basali sat brevi. ♂.

Male black, the mandibles with a small yellow spot at the base. The clypeus, a small spot on the scape of the antennae, one behind their insertion, two on the prothorax, others on the tegulae, and the postscutellum, yellow, as well as the apical margin of the two basal abdominal segments. No doubt these yellow markings would be variable in a series of examples. Head dull, subobsoletely punctured; thorax dull, evidently, but somewhat irregularly, punctate, and with the system of interstitial minute puncturation distinct; scutellum irregularly punctured, the propodeum dull, with the surface somewhat roughened by large subobsolete punctures. Abdomen with the basal segment feebly punctured; second convex, distinctly punctured on its yellow apical margin; beneath, its basal portion is short, the costae are distinct, and there is no depression beyond them. All the tibiae have a yellow line above. The wings are infuscate, and have a slight blue iridescence.

Hab. Probably from Oahu (Beechey expedition). A single ♂ example in the British Museum under the name of *O. nautarum*, de Sauss. The description of that species says "le métathorax seul ponctué," which will not at all agree with the insect above described. This species might be placed near *O. insulicola*, Blk.

Two species described by the Rev. T. Blackburn, *O. hawaiiensis* and *O. haleakalae*, I have not been able to identify with any certainty, not having seen the original specimens. Mr Blackburn very kindly sent me an example under the former name, but it was quite clearly not the subject of his description. This example belongs to the species I have called *O. pterocheiloides*, and is excessively closely allied to *O. congruus*, Smith. There is no trace of tuberculation on the second segment of the abdomen, and this alone is sufficient to distinguish it from *O. hawaiiensis* as described, but it is certain from the remarks made at the end of the description of *O. hawaiiensis*, that several species were included under that name. As regards *O. haleakalae* I cannot refer it for certain to any particular one of the species found on Maui. There is no doubt, however, that both these species will prove referable to two of the species which I have described under new names. Possibly *O. hawaiiensis*, Blk. is the same as my *O. erythrognathus*, and *O. haleakalae*, Blk. as *O. ecostatus*.

ANTHOPHILA.

Obtusilingues.

Nesoprosopis, gen. nov.

Under this generic name I propose to separate certain bees which have hitherto been referred to the genus *Prosopis*, although at present it is necessary to rely on ♂ characters for the separation. In all the species examined (and these comprise most of the 52 species known to me) the 8th ventral segment is highly peculiar, and although exhibiting great variety in detail, yet always maintains the same general form. Its apex is always produced into an extremely long process, which on the ventral side rises erect or suberect from the body of the segment. In its simplest form the process is a delicate curved rod, expanded at the apex, or more usually bifurcated, the bifurcations being more or less recurved. On its apical portion at least it is clothed with long hairs. In many of the species the process is greatly expanded dorso-ventrally, so that in extreme cases it may be nearly as wide as long, and the apical bifurcations are also sometimes greatly expanded. All intermediate conditions between this and the simple form may be seen in the various species known from the islands.

The extreme apex of the process is always exposed in life, showing beyond the sixth segment, which is more or less compressed or carinate, and emarginate at the apex, the ventral surface of a part of the process resting within the carina. The seventh segment is entirely concealed, and in strong contrast with the eighth shows little specific modification. It is produced at the apex into two processes, one on either side, which are more or less bent downwards. These processes are longer in some species than others, and are not hairy as is the apical process of the eighth segment.

The genital armature itself is also remarkably similar, even in the most widely separated species. The stipites are thin, somewhat concave inwardly, and simple, there being no trace of a lacinia. On the apical portion they are always clothed with long hairs. The sagittae do not extend as far as the apex of the stipites, being strongly curved downwards a little before that point is reached, or in one or two species (owing to the length of the stipites) considerably before.

The sculpture of the various species is remarkable for its feebleness. The puncturation is always fine and shallow, and excepting a group of species, which are relatively of very great size, there is in no case any definite abdominal puncturation. This extraordinary similarity of sculpture adds greatly to the difficulty of differentiating the species. The anterior area of the propodeum is but ill-defined, and its posterior face always bears a longish erect pubescence.

The habits of the bees of this genus exhibit considerable variety. On the coast and dry mountain slopes they form their burrows in the ground, but in thick forests and wet districts their cells are made in dead wood, generally of standing trees. The larval food contains comparatively little pollen, as these bees have no special pollinigerous apparatus, and in cells that I have opened the larva was floating on the liquid food. Such pollen as is collected is swept towards the mouth by the curved hairs on the anterior tarsi, an dregurgitated with the honey. Some species are quite peculiar to the coast region, others to the forests, and a few to the region above the forest line. A few are found in dense and gloomy woods, which bees would hardly be expected to inhabit, and may be seen flying round some bush, where a little sunlight is able to penetrate.

In the following descriptions I have used the term 'anterior area' for that part of the propodeum called by Smith 'the enclosed space of the metathorax,' the 'basal area' of many other hymenopterists. In the Hawaiian species it is not enclosed, and should, I think, rather be called the apical than basal area. In any case the term used avoids any possible confusion. All the known species, where possible, have been redescribed, the old descriptions being insufficient for their determination.

The species of *Nesoprosopis* form several more or less definite groups. One of these is easily distinguished by the evidently punctate abdomen of both sexes, and the large, robust form, at least of the females. *N. fuscipennis* is typical of this group, to which also must be referred *N. andrenoides*, a most remarkable species, resembling at first sight a medium-sized or rather small *Andrena*. It differs from all the other large species in its nearly impunctate metallic abdomen, which bears fasciae of white pubescence. A second group is defined by its parasitic habits, and the clothing of the front tarsi of the ♀, the hairs of which have not the regular curved form of the industrial species. The females of all the parasitic species but one have the abdomen ferruginous at least at the base, but in two species the males are black or nearly so. Very closely allied to this group is another, the females of which are industrial, and provided with well-developed curved sweeping hairs on the front tarsi. The face is always long, and the pubescence of the front of the head is very short and inconspicuous. The remaining species form several ill-defined groups, none of which are parasitic, and in all the abdomen is impunctate or nearly so. The front of the head is clothed with more or less long hairs, at least in those which have the face elongate. Several species are distinguished by their small size, narrow form, and the more than usually long dorsal surface of the propodeum. *N. crabronoides* is the most striking species of this group. Others are remarkable for the great width of the face across the eyes, *e.g.* *N. laticeps* and its allies. Finally there are a number of species closely allied to *N. facilis*, which comprise the least remarkable species of the genus. The face is not extremely short and wide, nor is the form very narrow; the dorsal surface of the propodeum is short. These three last-mentioned groups, however, seem to be connected by intermediate forms.

The specific characters of the ♂ are chiefly to be found in the amount of dilatation of the scape of the antennae, the markings of the face (which, however, vary a good deal in some species), and the relative length and width of the head. The eighth ventral segment, which it is necessary to extract for examination, also furnishes very useful characters. If the scape of the antennae be viewed from the front, so that the front edge instead of the flattened surface be examined, it will be seen to be more or less concave beneath. The height and form of the arch so formed often furnishes useful specific distinctions. The females are much more difficult to separate, and in a few cases I see no specific distinction between two species, although the males are quite distinct. The shape of the head and its puncturation in front, the sculpture of the anterior area of the propodeum, the colour of the wings, and of the hairs on the apical segment of the abdomen, as well as the facial and prothoracic markings when present, furnish the most useful characters.

(1) *Nesoprosopis facilis.*

Prosopis facilis, Smith, J. Linn. Soc. XIV. p. 683.

Prosopis facilis, Blackburn and Cameron, P. Manch. Soc. Vol. XXV. (1885—86), p. 142. (Plate II. fig. 1, and fig. 8—8 *h*.)

Male black, with the clypeus, the plate above it, and an elongate spot on either side adjoining it, flavous; front tibiae and more or less of the front femora testaceous inwardly, intermediate and posterior legs black or nearly so. The sides of the face are widely and deeply depressed along the inner margins of the eyes; the antennae black with the scape dilated, about twice as long as wide, and strongly arched beneath; head above the antennae with the surface rough, shallowly punctured, clothed with rather long pubescence; mesothorax dull, with fine and shallow puncturation, that of the scutellum rather more distinct; wings more or less infuscate; propodeum longitudinally rugose to the brow, the rugosities more regular in some individuals than others; abdomen with the surface rugulose, with hardly definite or visible puncturation; beneath, with the sixth segment emarginate at the apex and carinated behind the emargination; process of the eighth sublinear, rising erect from the body of the segment and curved, bifurcate at its apex, very densely clothed with hairs on its apical half, the bifurcations with a long and regular fringe; genitalia with the stipites much produced at their apex, with long hairs on their outer margins, which do not extend to the extreme apex, being almost absent on the submembranous apical portion.

Female black, without any yellow markings on the face; head above the antennae pubescent as in the ♂, the antennae simple, and the face much wider between the eyes: mesothorax with very similar puncturation, but generally more clearly defined, as also is the anterior area of the propodeum, and more regularly longitudinally rugose; abdomen without definite puncturation, the terminal segments with dark pubescence above and beneath. Length, 6—9 mm.

HAB. Common generally on Oahu, Maui, Lanai, and Molokai, in dry or moderately dry localities, from the coast to an elevation of 4000 ft. in the mountains.

OBS. This is not a very variable species so far as the facial markings of the ♂ are concerned. The elongate spots adjoining the clypeus and that on the plate behind it are sometimes diminished in size or rarely absent. The latter part, although its sides are always longer than the apical margin, is variable, the length of the sides being considerably greater (in proportion to the length of the anterior margin), in some examples than in others. Those from Maui, Lanai and Molokai have this plate extremely long and narrow, but not more so than in some Oahuan specimens. The latter often have the wings clearer, and with a less distinct blue iridescence than those from the other islands, they are also on the average of smaller size, and the pubescence of the mesothorax is often paler in colour.

(2) *Nesoprosopis chlorosticta*, sp. nov.

Praecedenti colore ac puncturatione simillima, sed ♂ tibiis tarsisque posticis basi flavo-maculatis, capite latiore distinguendus. ♂ ♀. Long. 6—7·5 mm.

This species is very closely allied to the preceding, but the ♂ is easily distinguished by the yellow base of the posterior tibiae and tarsi, and apparently is not variable in this respect, as I have examined a fine series. It also has the face evidently wider across the eyes than *facilis*. The female is much more difficult to separate, but the face appears to be slightly wider, and the average size of the insect considerably less.

Hab. Mountains of Kauai (2000—4000 ft.). It is also found on the coast.

(3) *Nesoprosopis simplex*, sp. nov.

Praecedentibus simillima; ♂ tibiis posticis haud flavo-notatis; genitalium stipitibus minus productis, et usque ad apices longe ciliatis, distinctus. ♂ ♀. Long. 6—9 mm. (Plate II. fig. 9.)

In general appearance and puncturation very like the two preceding species; the ♂ may be known at once from *N. chlorosticta* by the entirely dark posterior tibiae, and from either by the genital armature, the stipites of which are less produced, and fringed right up to the apex with long hairs. The plate above the clypeus is very variable in its proportions, the length of its lateral margin being sometimes longer, sometimes equal to, or even shorter than its anterior margin. I see no character to separate the ♀ from that of *facilis*; the wings are strongly and entirely infuscate with evident blue iridescence, wherein they especially resemble examples of that insect, from Maui and Molokai, although their average size is less.

Hab. Island of Hawaii, generally distributed from 1500—4000 ft. elevation, and abundant.

(4) *Nesoprosopis hirsutula*, sp. nov.

Praecedentibus cognata, sed capite latissimo, latiore quam longiore; ♂ tibiis basi longe flavescentibus, tarsis haud maculatis; segmento ventrali 8° apice haud longe bifurcato, bene distinctus. ♂ ♀. Long. 6—9 mm. (Plate II. fig. 10—10 *c*.)

Male with the face very broad, transverse, the scape of the antennae slightly dilated, not quite so much as in *N. facilis*, &c., nor quite so strongly arched beneath: the clypeus, a small spot on either side of it, and the plate above it, pale yellowish-white. The latter two markings are variable, sometimes absent. The plate above the clypeus is very wide; cheek between the eye and mandible extremely short; clypeus clothed with rather long erect hairs, generally of an obscure colour; head above the antennae with long, dark pubescence, and roughly punctured. Thorax with rather long obscure pubescence; puncturation very like that of *facilis*, sometimes perhaps rather stronger; posterior tibiae white at the base, but the tarsi dark; eighth ventral segment of the abdomen with the process without long apical bifurcations.

Female very like the ♂, the face very wide with obscurely-coloured pubescence: cheek extremely short; the scutellum more or less shining; apical segments of the abdomen above and beneath with the hairs black or of an obscure colour.

HAB. Mountains of Kauai, 3000 ft., and on the high plateau.

(5) *Nesoprosopis difficilis*, sp. nov.

Nigra, mesonoto griseo-pubescente, subtiliter nec dense punctato, propodeo antice rugoso, alis plus minusve hyalinis, haud caeruleo-iridescentibus; ♂ articulo 1° antennarum dilatato, subtus fortiter arcuato, bis longiore quam latiore; capite prae antennis, necnon saepe tibiis tarsisque plus minusve flavescentibus; genitalium stipitibus apice rotundatis ac fimbriatis, haud productis; ♀ pedibus, segmentisque abdominis apicalibus pallide pubescentibus. ♂ ♀. Long. 5—8·5 mm. (Plate II. fig. 11—11 *c*.)

♂ Black, with the clypeus, the plate above it, and a spot on each side adjoining it, yellow; anterior tibiae pale in front; antennae with the flagellum often more or less pale beneath; the posterior legs often have the tibiae and basal joint of the tarsi more or less yellow, sometimes also the intermediate legs are similarly coloured. All these markings are variable, the posterior and intermediate legs are often entirely dark. The general appearance is that of *N. facilis*, &c., the head being of similar form and in typical specimens similarly marked.

Antennae with the scape dilated as in *N. facilis*, about twice as long as wide, and strongly arched beneath; plate above the clypeus generally short, the length of each of its sides to the antennal fossa subequal to or less than the length of its anterior margin; cheeks between the eye and base of the mandibles short; head above the antennae dull, with roughened surface, closely and shallowly punctured, clothed with long grey hairs. Mesothorax and scutellum clothed with somewhat long, erect, grey pubescence, puncturation much as in *N. facilis*, &c., the punctures fine and very shallow, but not very close, the fine rugosity of the surface and the pubescence generally giving them an indistinct appearance; anterior area of the propodeum longitudinally rugose, wings subhyaline, or quite clear in fresh examples. Abdomen as in *N. facilis*; genital armature with the stipites rounded at the apex, not at all produced, evenly fringed with long hairs; eighth ventral segment apparently rather variable, its process towards the apex clothed with hairs, but with a less dense covering than that of *N. facilis*, its apex not bifurcated into long branches, but usually only slightly dilated at the extremity, rarely with the angles of the dilatation more or less produced.

Female in general appearance very like that sex of *N. facilis*. Head above the antennae dull, with roughened surface, closely and shallowly punctured, clothed with long pubescence. Mesothorax very finely punctured; propodeum with the anterior area more or less regularly longitudinally rugose; wings hyaline or subhyaline without blue iridescence; abdomen without definite puncturation, calcaria testaceous; legs and the apical segments of the abdomen above and beneath with pale pubescence.

HAB. Molokai, Lanai, Maui and Hawaii; abundant in the mountains. This is a most perplexing species on account of its variability. In general appearance and sculpture it greatly resembles *N. facilis* and the allied forms. The yellow markings of the face in the ♂ are variable, being sometimes reduced in size, or altogether absent except that of the clypeus, which is always yellow over at least the greater part of its surface. Structurally the ♂ is quite distinct from the three species first described, by the simply rounded apex of the genital armature, which is not at all produced, and by the differences in the process of the 8th ventral segment. The female may be known by the clearer wings which are without blue iridescence and by the pale pubescence of the legs, and terminal segments of the abdomen. Sometimes the abdomen is of an immature reddish colour, as is also the case in other of the Hawaiian species which are normally black, the paler forms being apparently produced when the individuals arrive at maturity after an unusually short period has been occupied in the earlier stages.

(6) *Nesoprosopis lacta*, sp. nov.

Nigra, subnitida, praecedenti simillima, sed mesonoto et scutello subtilissime punctatis et laevioribus; metanoto minus rugoso; ♂ tuberculis pedibusque fere semper flavo-notatis; antennarum articulo primo fortiter arcuato; ♀ tuberculis saepe flavo-notatis, genis brevissimis. ♂♀. Long. 5—7 mm.

Closely allied to the preceding, the yellow markings variable. In the most brightly coloured males the following parts are yellow: the front tibiae in front and within, the intermediate tibiae inwardly, and the base and apex also outwardly; the posterior, except for a black spot towards the apex inwardly, and a more or less distinct fuscous stain outwardly; the basal joint of all the tarsi and sometimes also the apical ones, as well as the extreme apex of all the femora; the clypeus, the plate above it, an elongate spot on either side, and the tubercles of the prothorax are also yellow. In general the basal joint of all the tarsi, and the base of the posterior tibiae widely, are yellow. Of forty or fifty specimens of the ♂ one only has the legs entirely of an obscure colour, and this also has the tubercles black; while of about a score of the other sex, three or four have the tubercles black, and some of them have the posterior tibiae widely yellow at the base.

Male with the antennae formed much as in the preceding, the scape being strongly arched beneath, the lower surface of the flagellum pale; the plate above the clypeus as long to the antennal fossa, as the length of its apical margin, or rather longer; the cheeks between the mandible and eye very short. Mesothorax slightly shining, evenly clothed with pale hairs, very finely and shallowly punctured; the scutellum more shining, and also very finely punctured; propodeum finely longitudinally rugose in front. Abdomen without definite puncturation, the apex with pale hairs; process of the 8th ventral segment bifurcate at the apex.

Female generally with a spot on the tubercles of the prothorax, and sometimes the base of the tibiae and tarsi pale; wings subhyaline, cheeks very short as in the ♂; mesothorax slightly shining, and clothed with very short pale erect pubescence; scutellum smooth and shining, finely and sparsely punctured; propodeum finely longitudinally rugose in front; apex of the abdomen above and beneath with pale hairs.

Hab. Oahu both mountain ranges (2000—3000 ft.) and also on the coast at Waianae. Kauai, Makaweli (3000 ft.) and Halemanu (4000 ft.).

Examples taken on the coast of Molokai and Maui, which are of larger size, appear referable to this species, as also others (from the mountains of the former island), having the abdomen red. It is not improbable that both this species, and the preceding, as characterized above, in reality include several distinct forms.

(7) *Nesoprosopis kona.*

Prosopis kona, Blackburn, P. Manch. Soc. xxv. (1885—86), p. 144.

Female, black, with a narrow line bordering the eyes, two spots on the prothorax, the tubercles, a spot at the base of the anterior and intermediate tibiae, and the basal half of the posterior, yellow. Face somewhat long, the clypeus lightly emarginate at the apex, the head above the antennae clothed with long pale hairs, and shallowly punctured. Mesothorax and scutellum dull, with exceedingly minute and remote punctures. Anterior area of the propodeum with the longitudinal rugosities extremely short. Wings clear. Apical segment of the abdomen with dark hairs. All the tarsi dark.

Male, black, the whole face below the antennae yellow, and this colour is extended backwards along the margin of the eyes above the insertion of the antennae, as in *N. blackburni.* A line on the prothorax, the tubercles, all the tibiae, and the basal joints of the tarsi, yellow. The tibiae are spotted with black. Basal joint of the antennae dilated, not so wide as long, the sides strongly rounded. Thorax, dull with very fine and remote puncturation, propodeum more shining, and with some oblique wrinkles. Length 5—7 mm.

Hab. Kona, Hawaii (4000—6000 ft.). I have only seen the ♀ of this species, and the description of the ♂ is condensed from that given by Blackburn (*l.c.* supra). Although the coloration of the face is like that of several species of the *N. blackburni* group, I believe this species is more closely related to *N. facilis* and its allies.

(8) *Nesoprosopis volcanica*, sp. nov.

N. difficili simillima, ♂ antennarum articulo primo subtus levius arcuato, lamina supraclypeari angustiore, genis longioribus, segmenti 8^i apice longe bifurcato; ♀ genis longioribus, scutello magis opaco distinguenda. ♂♀. Long. 6—8 mm. (Plate II. figs. 12—12*b*.)

This species has the form and general appearance of *N. difficilis*, and the facial markings of the ♂ are similar to those of that species, and similarly variable. The legs are nearly always entirely dark, without yellow markings.

Male, with the scape of the antennae rounded on its posterior margin, about twice as long as wide, as in most of the foregoing species, but very distinctly less strongly arched beneath; cheeks between the mandible and eye longer, and the plate above the clypeus narrower in proportion to its height, than in *N. difficilis*. Mesothorax and scutellum dull from the surface rugulosity, clothed with long grey hairs, as also is the front of the head behind the antennae; wings clear in fresh examples. Process of the 8th ventral segment with long delicate bifurcations at its apex.

Female, very like the ♂ apart from sexual differences, the head and thorax being similarly clothed, the cheeks unusually long, the scutellum quite dull, the wings hyaline or subhyaline.

HAB. Hawaii, near the active crater Kilauea, where it is abundant. I have also taken it in the Kona district at a similar elevation (4000 ft.), and at the bottom of the crater of Haleakala, Maui (7000 ft.).

(9) *Nesoprosopis nivalis*, sp. nov.

Nigra, opaca, genis longissimis, capite et mesonoto pubescentia longa vestitis; ♂ capite, ut praecedentis, flavo-decorato, utrinque juxta oculos fortiter depresso; antennarum articulo primo fortiter dilatato, lateribus rotundatis, longiore quam latiore; ♀ scutello opaco, aequaliter distincteque punctato. ♂♀. Long. 6—8 mm. (Plate II. figs. 13 and 13*a*.)

Male, with the face very long and narrow between the eyes, the cheeks between the mandibles and eyes extremely long; the clypeus, the plate above it and a spot on each side of it, yellow; these markings are variable, the spots varying in size, and those outside the clypeus may be entirely wanting; antennae with the scape much more strongly dilated than in the preceding species, having both its anterior and posterior margins rounded, but its length is evidently greater than its width. The face is very deeply depressed at the sides, then strongly raised round the antennal fossae, forming a ridge which partly encircles them. Mesothorax dull, clothed with long grey hairs, the surface finely roughened, with very shallow, obscure and rather close puncturation; scutellum with close shallow punctures; the anterior area of the propodeum longitudinally rugose; the base of the posterior tibiae, and the basal joint of the posterior tarsi, pale. Abdomen with the 6th ventral segment emarginate at the apex, and carinated behind the emargination, its sides also emarginate; process of the 8th shortly bifurcated at the apex, or apparently sometimes truncate.

Female, very like the ♂ apart from sexual differences; entirely black, with the face very long between the eyes, and the cheeks extremely long; head and thorax clothed as in the ♂. Mesothorax dull, finely, closely and shallowly punctured; scutellum with very distinct, close, and even, but shallow puncturation; apex of the abdomen with pale hairs.

Hab. Haleakala, Maui, above the forest nearly to the summit of the mountain (10000 ft.). Frequents the flowers of *Cyathodes* etc. and is very abundant, but I took only a small series.

(10) *Nesoprosopis rugulosa*, sp. nov.

♀ nigra, griseopubescens, haud nitida, mandibulis truncatis, haud distincte dentatis; genis brevissimis; mesonoto densissime ruguloso, subtiliter punctato; propodei area antica irregulariter rugosa; abdominis segmentis ventralibus distinctius ciliatis; alis subhyalinis. ♀. Long. 6 mm.

Female, black, antennae with the flagellum sometimes pale beneath; head with grey pubescence, mandibles somewhat obliquely truncate at the apex, and not toothed; cheeks extremely short, so that towards the clypeus the base of the mandible nearly touches the eye; the clypeus is closely and very shallowly punctured, the punctures ill-defined; the suture of its lateral margins with the sides of the face somewhat deeply impressed; head above the antennae closely and rather largely, though shallowly punctured. Mesothorax with grey pubescence, its surface dull, densely and excessively finely rugulose, the puncturation fine, shallow and indistinct; scutellum more largely punctured; propodeum irregularly rugose in front. Abdomen with the basal segment hardly shining; intermediate ventral segments pale at their apices, and rather distinctly ciliated along them with white decumbent hairs.

Hab. Kilauea, Hawaii (4000 ft.), 2 ♀. I do not know the ♂.

(11) *Nesoprosopis vicina*, sp. nov.

♀ nigra, genis brevibus, capite supra antennas levissime rugoso, haud dense punctato; mesonoto aequaliter subtiliter punctato; propodeo antice longitudinaliter rugoso; abdominis segmento primo pernigro, nitido, subtilissime ruguloso; alis subhyalinis. ♀. Long. 6 mm.

This species is extremely like several of the preceding, but without doubt distinct. The mesothorax and scutellum are quite dull, smooth except for the very fine rugulosity of their surface, clothed with short pubescence, and finely and evenly punctured; the mesopleurae are not at all strigose or rough but are finely punctured. The basal segment of the abdomen is deep, black and shining; the apical segments clothed with dark pubescence.

Hab. Olaa, Hawaii (2000 ft.); a rare species. I took only two or three specimens, and have not seen the ♂.

(12) *Nesoprosopis koae*, sp. nov.

♀ nigra, praecedenti simillima, capite supra antennas minus opaco, et distinctius punctato; thorace minus opaco; alis infuscatis, ad apices subcaeruleo-iridescentibus, facile distinguenda. ♀. Long. circa 6 mm.

This is a very distinct species; the thoracic puncturation appears to be identical with that of the preceding, but the head above the antennae is less dull, and more distinctly punctured; the mesothorax less dull, and the scutellum somewhat shining.

The wings are entirely infuscate, with distinct bluish iridescence on their apical portion in certain lights. The longitudinal rugosity of the propodeum is unusually short. The basal segment of the abdomen deep black, and shining, as in the preceding, and the apical segments clothed with black hairs.

Hab. Mountains near Honolulu, Oahu (above 2000 ft.). A single specimen was taken in 1892. In March, 1897, three more females were taken from the blossoms of *Acacia koa.*

(13) *Nesoprosopis connectens*, sp. nov.

♂ niger, clypeo macula flava magna ornato, capite brevi, trans oculos lato, lamina supraclypeari latiore quam longiore; antennarum articulo primo haud fortiter dilatato; alis infuscatis; segmenti 8^{i} ventralis parte producta minus fortiter dilatata, apice bifurcato et ciliato. ♂. Long. 6 mm.

Male, black, the clypeus with a large yellow spot, the front tibiae yellow inwardly. Face short and wide across the eyes, the apical margin of the plate above the clypeus much longer than its side to the antennal fossa. Antennae with the scape about twice as long as wide, and strongly arched beneath. Head above the antennae finely rugulose, dull, and very shallowly punctured. Mesothorax and scutellum finely punctured, dull, the pubescence of the former short. Propodeum longitudinally rugose in front. Wings rather strongly infuscate, and with a slight blue iridescence. The process of the 8th ventral segment of the abdomen is evidently but not at all strongly dilated, its apical bifurcation more strongly so, and ciliated with long hairs.

HAB. A single ♂ was taken in the Iao valley, Maui. A female captured with it is evidently of the same species, and is very closely allied to *N. koae*, but this example is much mutilated. A single ♀ taken on Lanai is also extremely close to, if not identical with, one of these species.

(14) *Nesoprosopis melanothrix*, sp. nov.

Nigra, capite, thorace et abdominis segmentis apicalibus densius nigro-pubescentibus; propodei rugis longitudinalibus antice brevissimis, vel absentibus; mesonoto et scutello subaequaliter punctatis; alis infuscatis caeruleo-iridescentibus; ♂ capite prae antennis toto nigro, aut maculis tribus flavis ornato; antennarum articulo 1° fortissime arcuato, scutello opaco; ♀ scutello nitido, clypei apice distincte angulatim emarginato. ♂♀. Long. 6—8 mm. (Plate II. figs. 14—14 *c*.)

Male, entirely black, except the testaceous front of the fore tibiae, or with the clypeus, and a spot on each side bordering the eyes, yellow, or with the latter markings only present; the clypeus is more or less emarginate at the apex, clothed with dark, and rather long, erect hairs, somewhat largely but shallowly punctured, the plate above it is similarly punctured, generally much wider than long, but variable in this respect; head above the antennae, and the vertex, with very long dark hairs, densely and rugosely punctured, and dull; antennae with the scape dilated, its posterior margin rounded but not strongly, the dilated surface evidently not twice as long as wide; beneath exceedingly strongly arched, so that when the anterior margin is viewed from in front the apex appears to be strongly produced, both base and apex being much thickened owing to the deep concavity of the part between. Mesothorax with long erect black hairs, shallowly and rather closely punctured, its surface dull and rugulose between the punctures; scutellum similarly clothed and dull, the punctures rather larger than those of the mesothorax; propodeum with very short ill-defined longitudinal rugosity in front, sometimes obsolete: behind this the surface finely rugulose, its sides clothed with pubescence of an obscure colour; wings infuscate, with blue iridescence; thorax beneath, and the legs with dark pubescence. Abdomen very finely rugulose, and hardly shining; beneath, shallowly punctured; 6th segment with the apex emarginate, and carinated behind the emargination; 8th with the process strongly dilated dorso-ventrally, the ventral edge densely hairy, its apex bifurcate, the bifurcations expanded, fringed with long hairs along their ventral margins.

Female, very like the ♂ in general sculpture, &c., clothed with similar dark pubescence; clypeus with its apical margin smooth and shining, and angulately emarginate; scutellum shining between the punctures which are distinct and even; propodeum often with a few very short wrinkles from its front margin, beyond these the surface smooth (except for the fine rugulosity of the surface), and slightly shining; wings quite dark, with very distinct blue iridescence; fifth and sixth ventral segments of the abdomen with long black hairs.

Hab. Haleakala, Maui (5000 ft.). In 1894 a small colony of this species was found burrowing in the hard dry trunk of a dead, but still standing, Ohia tree (*Metrosideros*). From this a short series of females was obtained, as they returned to their burrows. In October 1896 an enormous colony was found high up in a dead and decayed tree of *Straussia*, and most of the specimens examined (about 50 in number) were obtained as they flew wildly over the ferns in the immediate vicinity of the colony.

(15) *Nesoprosopis haleakalae*, sp. nov.

Nigra, capite trans oculos lato; mesonoto et scutello aequaliter punctatis; area propodei antica fortiter clathrate rugosa; alis fuscis; ♂ maculis tribus prae antennis flavis; antennarum articulo 1° dilatato, multo longiore quam latiore, margine antico subtus vix arcuato; segmenti ventralis 8^{i} productione fortius dilatata; metatarsis posticis saepe plus minusve pallidis. ♂♀. Long. 6—7 mm.

Male, with a spot on the clypeus, and one on each side of the face without it, yellow; front of the front tibiae, and sometimes all the tarsi testaceous; base of the posterior metatarsi generally more or less pale, sometimes only obscurely so; the facial markings are more distinct in some examples than others, but I have seen none in which they are wanting.

Face wide across the eyes, and strongly convex from the ocelli to the apex of the clypeus; the latter distinctly but shallowly punctured, clothed with long hairs, the plate above it wide and punctured; the scape of the antennae dilated, but much longer than wide, its anterior margin when viewed from in front almost straight beneath, not concave or arched; if, however, the under surface be examined, it will be seen to be deeply concave as in other species, only the concavity in this species does not extend quite so far as the anterior margin; head above the antennae with long dark hairs, exceedingly densely punctured towards the middle, where the close sculpture forms a distinct deep black area; thorax and scutellum dull, with erect dark pubescence, and closely and evenly punctured; the whole of the anterior area of the propodeum is somewhat coarsely clathrately rugose; abdomen with the apical process of the 8th ventral segment dorso-ventrally expanded, its bifurcate apex also dilated, and beautifully fringed with long hairs.

Female, apart from sexual characters very like the male; in some examples there is a very narrow yellow line along the inner margin of the eyes, or the head may be entirely black; face very wide, and very strongly convex longitudinally, with long dark pubescence; propodeum coarsely clathrately rugose to the brow, as in the ♂; apical segments of the abdomen beneath with dark hairs; wings in both sexes fuscous, often with slight blue iridescence towards the tips.

Hab. Haleakala, Maui (4000—5000 ft.). Not a common species; found flying round ferns in the forest. It is very distinct by the structure of the scape of the ♂, and the clathrate area of the propodeum in both sexes.

(16) *Nesoprosopis unica*, sp. nov.

♂ capite latissimo, fortius transverso, longitudinaliter fortiter convexo, clypei apice, et magnis duabus maculis extra clypeum, flavo; pronoto interrupte flavo-lineato: metatarsis pallidis; alis subfuscis; antennarum articulo primo dilatato, longiore quam latiore, subtus fortiter arcuato; area propodei antica breviter subreticulatim-rugosa. ♂. Long. circa 6 mm.

Male, head very wide, across the eyes decidedly transverse; face with a spot near the apex of the clypeus, and two large triangular ones bordering the eyes, and also a widely interrupted line on the hind margin of the prothorax, yellow; clypeus with its posterior margin extremely wide, the sides very little divergent thence as far as the apex of the eyes, evenly punctured, and clothed with rather long pale hairs; plate above the clypeus very wide, its anterior margin about equal to the combined length of its sides; face very convex longitudinally; the scape of the antennae dilated, subtriangular, its posterior margin rounded, longer than wide, beneath somewhat strongly arched; head above the antennae with the surface finely roughened, and somewhat closely punctured. Mesothorax and scutellum with dark erect pubescence, finely, regularly and closely punctured, the scutellum rather the more largely, and its surface slightly less dull than that of the mesothorax; anterior area of the propodeum subreticulately rugose along its front margin, behind this smooth except for the surface rugulosity; wings fuscous; the front of the front tibiae, and all the metatarsi, pale.

Hab. A single male taken in the mountains near Honolulu at an elevation of about 2500 ft. (1897).

(17) *Nesoprosopis laticeps*, sp. nov.

Praecedenti affinis, capite transverso, fortiter convexo, alis fuscis; ♂ antennarum articulo primo dilatato, longiore quam latiore, subtus fortiter arcuato; capite prae antennis ad latera flavo-maculato, vel toto nigro; ♀ propodei area antica brevissime antice rugosa; capite supra antennas in media parte subirregulariter punctato. ♂♀. Long. 6—8 mm. (Plate II. figs. 15—15 *b*.)

Male, face entirely black, or with two yellow spots, one on each side between the eye and clypeus; face transverse, the plate above the clypeus very broad, twice as wide as high; head above the antennae punctured, and clothed with obscure pubescence, as also the thorax; mesothorax dull, very finely punctured, scutellum somewhat more largely but not very closely; anterior area of the propodeum generally with some short rather strong longitudinal wrinkles at the extreme front. In some examples these are longer than in others and less regular, but they do not reach the posterior margin of the area, which has only the usual rugulose sculpture of the surface. Front legs pale in front, tarsi generally more or less testaceous; wings entirely fuscous with more or less blue iridescence; 8th ventral segment of the abdomen with the process dilated, as also its apical bifurcations.

Female, very like the male apart from sexual characters; head very wide and strongly convex, above the antennae very finely strigose and finely punctured, the punctures rather remote towards the middle; mesothorax and scutellum dull, clothed and punctured, as in the ♂; propodeum with the anterior area smooth, except for the rugulosity of its surface, and some extremely short wrinkles at the front margin, sometimes obsolete; wings as in the ♂, legs dark, apical segments with black hairs.

HAB. Dense wet forests high up on the mountains of Molokai, (above 4000 ft.). Not common, flying rapidly over ferns in places where the sunlight can penetrate the brush. On Lanai (2000—3000 ft.) the species is found of considerably smaller average size but (so far as I can see) inseparable from the Molokai examples by any constant character. The localities where it is found on Lanai are much less wet, and less heavily timbered, than those on Molokai, but appear to have been of much the same character before the forest had been so much thinned out and destroyed.

(18) *Nesoprosopis neglecta*, sp. nov.

Forma facieque praecedentis, capite supra antennas circa medium densissime rugoso-punctato, propodei area antica irregulariter fere tota rugosa, bene distincta. ♀. Long. 7 mm.

Of the same general form and appearance as the preceding but no doubt distinct. The head above the antennae is very densely subrugosely punctured, and the propodeum rather finely and irregularly rugose right up to the brow, whereas in *N. laticeps* the rugosity is extremely short, and the brow itself slightly shining.

HAB. Mountains of Molokai in the high boggy forest. Sept. 21st, 1893. 1 ♀ taken.

(19) *Nesoprosopis kauaiensis*, sp. nov.

Forma fere praecedentium, N. unicae cognatissima; alis subhyalinis; ♂ clypeo, et duabus extra clypeum maculis, pallide flavis; pronoto postice interrupte flavo-lineato; ♀ lineis duabus juxta oculos flavis, margine postico pronoti ad latera flavo-lineato. ♂♀. Long. 6—7 mm.

Male, with the scape of the antennae and the form of the head much as in the preceding species; clypeus almost entirely, a spot on each side of the face outside the clypeus, and the hind margin of the prothorax at the sides, very pale yellow; the posterior edge of the clypeus strongly rounded; head with long dark pubescence. Mesothorax dull, and closely punctured, densely clothed with black pubescence; scutellum closely and evenly punctured; propodeum with the anterior area longitudinally rugose in front, the rugosities short, not reaching the brow; posterior tibiae and tarsi normally dark, sometimes, when the abdomen is of a more or less reddish immature colour, they are more or less pale; 8th ventral segment of the abdomen much as in the allied species.

Female, in general sculpture and form like the ♂; two spots on the prothorax, and a line on each side of the face near the eyes, pale yellow; mesothorax and scutellum quite dull, evenly and closely punctured; propodeum with a few longitudinal wrinkles of moderate length, not reaching the brow; basal segment of the abdomen shining and very smooth; apical segments with dark hairs.

Hab. Mountains of Kauai (3000—4000 ft.); taken on several occasions, but scarce. The large pale markings of the face in the ♂, and the spotted collar and clear wings in both sexes, give this little species a very distinct appearance.

(20) *Nesoprosopis comes*, sp. nov.

Nigra, capite longitudinaliter minus fortiter convexo; mesonoto opaco, subtiliter minus dense punctato, pilis fuscis longioribus vestito; scutello haud nitido, minus dense subirregulariter punctato; propodei area antica subtiliter irregulariter rugosa; alis plus minusve infuscatis; ♂ clypei apice flavo-maculato; antennarum articulo primo dilatato, longiore quam latiore, subtus modice arcuato; segmenti 8^{i} ventralis productione fortiter dilatata. ♂♀. Long. 6 mm.

Black, the ♂ with a spot of variable size (which would probably be sometimes absent) on the clypeus near its apex; front of the front tibiae pale, as is usual in this sex of most species. Male with the face short, but not of the great width of the several preceding species, nor nearly so convex longitudinally; plate above the clypeus short, the length of its side to the antennal fossa less than that of its anterior margin; head above the antennae with long fuscous hairs, with very dense sculpture about the middle, forming an area of a more deeply black colour than that of the general surface; scape of the antennae dilated, but very evidently longer than wide, its posterior margin rounded, the anterior nearly straight; the front margin seen from in front moderately arched beneath, much less deeply concave than in *N. kauaiensis*, *laticeps*, &c., in which species the arch is highest near the apex, while in this species it is highest about the middle of the length of the scape. Mesothorax with long fuscous hairs, quite dull, very finely and not very closely punctured about the centre; scutellum very slightly less dull, and with rather larger puncturation, the punctures somewhat sparse and irregular, not close and even as in *N. kauaiensis*, &c.; propodeum quite finely irregularly rugose in front, the rugosity becoming less evident posteriorly, the actual brow somewhat less dull than the part in front. Apex of abdomen with dark hairs; 8th ventral segment strongly dilated dorso-ventrally, and the apical bifurcations also expanded; wings somewhat infuscate.

Female, very like the ♂, but the face entirely black, clothed with similar dark pubescence; head much less convex longitudinally than that of *N. kauaiensis*, &c.; above the antennae the surface rather shining, distinctly punctured, the punctures slightly decreasing in size inwardly; along the middle line the sculpture is very dense, forming a quite opaque area. Mesothorax very finely and rather remotely punctured, quite dull from the fine rugulosity of the surface between the punctures; scutellum very slightly shining at the sides, less dull than that of the ♂, somewhat sparsely and irregularly punctured; propodeum as in that sex; basal segment of the abdomen rather dull, impunctate, the surface distinctly finely rugulose; apical segments with dark hairs.

HAB. Haleakala, Maui (4000—5000 ft.); rare, three males and one female taken in company with *N. haleakalae* and *N. melanothrix*.

(21) *Nesoprosopis coniceps*.

N. coniceps, Blackburn, P. Manch. Soc. Vol. XXV. (1885—86), p. 145.

A species taken on Hawaii, and very closely allied to the preceding, is I believe referable to the above. In sculpture &c. it seems hardly to differ from *N. comes* The clypeus has the basal part, the lateral margins and the extreme apex black, all the rest flavous, as well as two large triangular spots between it and the inner margins of the eyes; the base of the posterior tibiae and of the basal joint of the hind tarsi (and sometimes of the intermediate tarsi), are sometimes yellow; the process of the eighth ventral segment appears to be slightly less dilated than that of *N.*

comes. The female is somewhat variable, and I see no definite character to separate it from the single individual of that sex of the preceding.

HAB. Kilauea, Hawaii (4000 ft.), 1895 and 1896. Not common. Mauna Kea (6000 ft.), Rev. T. Blackburn.

(22) *Nesoprosopis dumetorum*, sp. nov.

Parvula, nigra, opaca, mesonoto subtilissime nec dense punctato, pilis nigris brevissimis vestito, propodeo antice brevissime rugoso, postice nitidulo; ♂ fronte tribus maculis flavis ornata; maculis quam praecedentis minoribus; pronoto utrinque, cum tuberculis et tibiarum basi, nonnunquam flavo-notato, nonnunquam his omnibus nigris; articuli antennarum primi margine antico subtus vix arcuato; ♀ duabus juxta oculos lineis flavis; pronoto postice ad latera, tuberculis, tegulis plerumque, cum basi tibiarum flavo-notatis; capite longitudinaliter fortissime (maris minus fortiter), convexo. Long. 4·5—6 mm.

In the male a spot near the apex of the clypeus, and one on each side of the face bordering the eyes, are yellow. These spots are generally much smaller than in *N. coniceps* though sometimes nearly as large; prothorax on each side, the tubercles, and the base of the tibiae, sometimes spotted with yellow, but more often all these are black. The head is shaped very like that of the two preceding species, but the front margin of the scape of the antennae is nearly straight, hardly arched, beneath; face above the antennae dull, and very densely and finely punctured about the middle, with a large deep-black area in contrast with the rest of the surface and on which the sculpture is exceedingly dense. Mesothorax very finely punctured, clothed with very short dark pubescence; scutellum with slightly larger punctures, but fine and not very close; propodeum rugose at the extreme front, behind this part the surface only rugulose, the brow sometimes, at least in certain aspects, slightly shining. Abdomen with the basal segment dull, with distinct surface rugulosity; eighth ventral segment with the process dilated, much as in *N. coniceps*; wings sometimes somewhat infuscate, but often hyaline.

Female, small, and very like the ♂ in most respects; face with only a narrow line along the eyes yellow; posterior margin of the prothorax at the sides, a spot on the tegulae (sometimes wanting), one on the tubercles, the whole front of the anterior tibiae, the extreme base of the intermediate, and the base of the posterior tibiae more widely, yellow; face strongly convex longitudinally, above the antennae hardly shining, but not so dull as in the ♂, and without the deep-black dull area of that sex, finely and closely punctured; mesothorax clothed, as in the ♂, with exceedingly fine puncturation, its surface quite dull; scutellum dull, very finely punctured, but quite evidently more strongly so than the mesothorax, the punctures not very close ; propodeum with very short rugosities at its anterior margin, behind these the surface finely rugulose, and about the brow in certain aspects quite brightly shining, as also beyond it ; apical segments of the abdomen with blackish hairs.

HAB. Hawaii from 2000—4000 ft. Taken in the heart of dense damp forests in places where a little sunlight penetrates, and may also be found at the edges of such forests. I have examined many examples. It is quite a distinct species, though the ♂ is very variable in colour.

(23) *Nesoprosopis mutata*, sp. nov.

Praecedenti magnitudine forma et colore simillima, ♂ capite supra antennas minus distincte punctato, et plaga pernigra carente, scutello vix opaco, segmenti 8[i] ventralis parte producta haud dilatata, antennarum articuli basalis margine antico subtus distincte arcuato ; ♀ scutello laeviore et nitido, tibiis posticis haud flavo-notatis bene distincta. Long. 5·5 mm.

This species represents on Kauai the *N. dumetorum* of Hawaii but is quite distinct. The head is similarly formed, but above the antennae the surface is rougher and the puncturation less distinct, and the ♂ lacks entirely the deep-black mark so conspicuous in the preceding ; the scutellum of the ♂ is decidedly less dull, of the ♀ even shining ; the eighth ventral segment has the process of a quite different form, not being dilated dorso-ventrally, nor evidently bifurcate at its apex.

The two males taken have the facial markings as in *N. dumetorum*, the tubercles, prothorax and legs black, as in some varieties of that species ; the single ♀ has the tegulae unspotted as in some examples of *dumetorum*, and the base of both posterior and intermediate tibiae also dark.

HAB. Kauai (3000 ft.) ; 2 ♂, 1 ♀ in a dense forest, flying over ferns in a sunny spot.

(24) *Nesoprosopis specularis*, sp. nov.

♀ nigra, praecedentibus simillima ; capite supra antennas minus subtiliter punctato ; spatio verticis, inter ocellum exteriorem et oculum sito, laevissimo nitidoque, ne minime quidem ruguloso ; clypei apice flavo-lineata, distinguenda. Long. 5·25 mm.

Female, like the preceding in size and general appearance, but the following characters will readily distinguish it. The head above the antennae is exceedingly closely and, for the size of the insect, rather strongly punctured : the surface between the punctures is smooth and shining ; the spaces connecting the exterior ocelli with the impressed longitudinal lines bordering the eyes are extremely smooth and shining, and the apical margin of the clypeus is yellow. The scutellum is perhaps hardly so dull as in *N. dumetorum*, but more so than that of *N. mutata*. Besides the line on the clypeus there is a long and rather broad yellow line along the inner margin of the eyes; the posterior margin of the prothorax at the sides, the tubercles, and the base of the posterior and intermediate tibiae are also marked with yellow; the clypeus is less convex longitudinally than that of *N. dumetorum*.

HAB. Hawaii; very rare, a single specimen only taken at Kilauea.

(25) *Nesoprosopis crabronoides*, sp. nov.

♀ nigra, angustula, capite supra antennas subnitido, dense distincteque punctato, vertice fortissime incrassato; mesonoto et scutello opacis, subtilissime punctatis. Caput prae antennis maculis duabus flavis lateralibus ornatum, pronoti margine postico ad latera, tuberculis, basique tibiarum, flavo-notatis. Long. 4·5—5 mm. (Plate II. fig. 2 and 2 *a*.)

Female, narrow and elongate, the face with two yellow lateral spots, and sometimes an obscure one near the apex of the clypeus; an interrupted line on the prothorax posteriorly, the tubercles, and the base of the tibiae, also yellow; head with the vertex extraordinarily incrassate, the face exceedingly strongly convex longitudinally, distinctly punctured behind the antennae, the surface between the punctures shining, as also the smooth spaces adjoining the exterior ocelli. Mesothorax very dull and finely punctured, clothed with short pubescence, scutellum with fine sparse puncturation; propodeum shortly rugose at the extreme front of its anterior area, which otherwise is very finely rugulose and shining: abdomen narrow and subelongate.

HAB. Kilauea, Hawaii (4000 ft.); rare.

This minute and remarkable species cannot be confounded with any other of the Hawaiian bees known to me. Its resemblance, when on the wing, to a minute species of *Crabro* is very great. A few burrows were found in the hard trunk of a large dead tree, which was still standing. Though I visited this tree on many occasions I took but few specimens—all females—the males neither coming to the burrows, nor visiting the flowers in the immediate vicinity.

(26) *Nesoprosopis mauiensis*, sp. nov.

N. mutatae simillima; ♂ clypeo nigro; extra hunc flavis duabus maculis; pronoto, tuberculis, tibiisque posticis haud flavo-notatis; capite supra antennas subrugose punctato; antennarum articulo primo fortius dilatato, margine antico subtus distincte arcuato; ♀ capite juxta oculos et margine postico pronoti ad latera, flavo-lineatis; tuberculis, tibiisque posticis haud flavo-notatis; scutello opaco. Long. 5·75 mm.

Male, with only a line bordering the inner margins of the eyes yellow, the clypeus, prothorax, tubercles and hind tibiae black; antennae with the scape rather more dilated than the other small and narrow species, its anterior apical angle somewhat prominent, and bent downwards, the front margin distinctly arched beneath; head above the antennae clothed with long sparse pubescence, and having an area about the middle of a deeper black than the general surface, but less distinctly marked than that of *N. dumetorum*; in front of this are two smooth spaces corresponding in shape to the dilated scape. Mesothorax and scutellum dull, with very minute punctures; propodeum at its anterior margin with extremely short rugosity, behind which the anterior area is smooth except for the fine surface rugulosity, and slightly shining; 8th ventral segment of the abdomen with the process and its apical bifurcations dilated.

Female, with a narrow yellow line along the margins of the eyes, and one on each side of the hind margin of the prothorax yellow; head above the antennae with the surface shining (except narrowly in the middle), finely and closely punctured; mesothorax dull, and very finely punctured; scutellum also dull, finely and somewhat remotely punctured; anterior area of the propodeum with only the fine general surface rugulosity and shining in certain aspects; wings clear and iridescent.

This species may be known from its ally on Kauai by the more dilated scape of the antennae, the entirely black clypeus, and different sculpture above the antennae of the ♂; the ♀ by the dull scutellum, and the more shining and more distinctly punctured head above the antennae; from *N. dumetorum* the distinctly arched anterior margin of the scape of the antennae beneath will distinguish the ♂, the black legs and tubercles the ♀.

HAB. Haleakala, Maui (5000 ft.). A pair (♂ and ♀) were dug out of a burrow, which was made in a very hard tree trunk, in April 1894. Subsequent visits in 1895 and 1896 failed to produce further specimens.

(27) *Nesoprosopis angustula*, sp. nov.

Nigra, *N. dumetorum* cognatissima, antennis ejusdem formae; ♂ frontis plaga pernigra vix distincta; ♀ capite tibiisque posticis nigris, haud flavo-notatis, illo supra antennas subnitido, distinguenda. Long. 5—6 mm.

Very close to *N. dumetorum*, the ♂ with the scape of the antennae similarly formed. Male with a yellow spot at the apex of the clypeus, and a well-marked triangular one along the inner margin of each eye; tubercles, posterior and intermediate tibiae and tarsi, black; head above the antennae very densely punctured about the middle, where there is no very distinct deep-black area, differing greatly from the surrounding sculpture. In *N. dumetorum* on close examination that area is found to be formed of a patch of extremely short and close-set black pubescence. Female with the face entirely black, the prothorax with small lateral yellow spots, and the tubercles are also marked with yellow; intermediate and posterior tibiae and tarsi black; head above the antennae especially towards the vertex distinctly shining between the closely-set punctures.

HAB. Lanai (2500 ft.); January 1894, very rare; 2 ♂, 1 ♀ only taken.

(28) *Nesoprosopis dimidiata*, sp. nov.

♂ capite prae antennis fere toto flavo, tibiis tarsisque flavis, illis nigro-maculatis, horum articulis apicalibus plus minusve infuscatis, tuberculis pronoti flavo-notatis; capite supra antennas dense ruguloso, minus distincte sparsim punctato; antennarum articulo primo multo longiore quam latiore, subtus modice arcuato; ♀ nigra, angustula, tibiis intermediis et posticis ad basim breviter pallidis; mesonoto cum scutello opaco, subtilissime punctato. Long. 5 mm.

Male, with the whole of the face below the antennae, except the upper part of the plate above the clypeus, yellow; antennae with the scape dilated, but considerably longer than wide, its anterior margin moderately arched beneath; head above the antennae dull, with the surface very finely roughened, and very shallowly, somewhat remotely punctured. Mesothorax dull and finely punctured; scutellum dull with shallow and not very close puncturation; propodeum with the anterior area rugose at the extreme front, otherwise only finely rugulose and dull, hardly shining even at the brow; tubercles of the prothorax with a yellow spot, all the tibiae and tarsi bright flavous, the front tibiae with a black spot behind, the intermediate and posterior with a black ring; apical joints of the tarsi more or less obscured in colour; pubescence of head, thorax and legs pale: the process of the eighth ventral segment dilated.

Female, entirely black, except the front of the anterior tibiae, which are yellow, the flagellum of the antennae, which is testaceous beneath, and the extreme base of the middle and posterior tibiae, which have a yellow spot. Face not at all strongly convex longitudinally, above the antennae rather shining, and finely punctured; mesothorax and scutellum quite dull, with exceedingly feebly impressed punctures; scutellum with very sparse, almost obsolete puncturation; propodeum with hardly any distinct rugosity at its anterior margin, the whole anterior area being very densely rugulose and dull, the brow shining in certain aspects, dull in others; basal segment of the abdomen hardly shining, the apical segments with pale hairs.

HAB. A single ♂ taken in Kona, Hawaii, at an elevation of 4000 ft. (Aug. 1892). The ♀ I have here described came, I believe, from the same locality, but unfortunately the locality label was lost.

(29) *Nesoprosopis blackburni.*

Prosopis blackburni, Smith, J. Linn. Soc. XIV. p. 682. Blackburn and Cameron, P. Manch. Soc. XXV. (1885–86), p. 143.

(Plate II. fig. 16—16 *d.*)

Male, with the whole face below the antennae bright yellow, which colouring is continued upwards behind them rather broadly along the margins of the eyes; labrum, the mandibles more or less, the tubercles and all the tibiae and tarsi are yellow, the tibiae generally with a testaceous stain or a black spot behind; the scape of the antennae has the front half of its upper surface yellow, and the flagellum fulvous or even yellow beneath. Face subrotundate, the cheeks between the eyes and mandibles very short; scape of the antennae hardly dilated, twice or more than twice as long as wide, the anterior margin widely but not deeply arched beneath; the plate above the clypeus is rather short but not wide; head above the antennae hardly shining, shallowly punctured, very densely in the middle immediately behind the antennae, with only a very short inconspicuous pale pubescence. Mesothorax rather smooth, the surface rugulosity being exceedingly fine, very finely and evenly punctured, and clothed with short pubescence; scutellum slightly shining; propodeum with its anterior area more or less longitudinally rugose; eighth ventral segment with the process dilated, and bifurcate at the apex, the bifurcations fringed with long hairs.

Female, with only the front of the anterior tibiae, and the under side of the flagellum of the antennae pale. Head very little convex longitudinally, above the antennae with only very short scanty pale pubescence, distinctly punctured, the surface between the punctures somewhat shining, at least in certain aspects; cheeks very short; mesothorax with very short pubescence, rather smooth but not shining, very finely and evenly punctured; scutellum shining, very finely but not very closely punctured; propodeum with the anterior area more or less longitudinally rugose in front and subopaque; legs and apex of the abdomen with pale hairs; wings clear. Length 5—6·75 mm.

HAB. Maui, but only on the coast and lowlands; common on the sandhills at Wailuku and near the coast at Lahaina.

The ♂ is very distinct from any other species, the ♀ is very like some of the following. This is the species described by Smith in his paper in J. Linn. Soc. (XIV. pp. 674—685), the types being in the British Museum. Mr Blackburn clearly had several quite distinct species before him, when he subsequently made some remarks on what he supposed to be *N. blackburni*. (P. Manch. Soc. *loc. cit.*)

(30) *Nesoprosopis longiceps*, sp. nov.

Praecedenti affinis, capite elongato, supra antennas densissime punctato, mesonoto opaco dense aequaliter punctato, propodei area antica rugosa, abdomine haud nitido, alis haud infuscatis; ♂ colore fere praecedentis sed mandibulis, pronoti tuberculis, antennarum articulo basali, tibiis posticis et intermediis (basi extrema excepta) nigris; tarsis omnibus plerumque flavis vel pallidis, rarius piceis. Long. 5·75—8·5 mm. (Plate II. fig. 3.)

Male, with facial markings like those of *N. blackburni*, but with the mandibles, the scape of the antennae, and generally the labrum, black; face extremely narrow between the eyes and longer than its greatest width across them; plate above the clypeus very narrow and elongate; head above the antennae very densely punctured, especially over the middle portion, the surface dull with short inconspicuous pale pubescence; the cheeks between the mandibles and eyes short; scape of the antennae twice or more than twice as long as wide, its anterior margin widely and shallowly arched beneath, the flagellum beneath fulvous. Mesothorax and scutellum hardly shining (often quite dull), closely and evenly punctured, clothed with grey pubescence; propodeum with the anterior area irregularly rugose to the brow—more strongly so in some examples than in others; wings in fresh specimens very clear, with dark neuration. Abdomen dull, without definite puncturation; eighth ventral segment with its process somewhat dilated, bifurcate at the apex, the bifurcations somewhat narrow and fringed with long hairs. The legs are variable in colour, but all the tarsi are generally yellow or at least pale; the posterior and intermediate tibiae are black with a yellow spot at the base and sometimes at the extreme apex; tarsi rarely entirely piceous.

Female, without yellow facial markings; the anterior tibiae pale in front; antennae with the flagellum fulvous beneath; face very long and narrow for this sex, the apex of the clypeus slightly emarginate; head above the antennae finely and very densely punctured (at least except at the extreme sides), dull, with short inconspicuous pale pubescence, the whole front hardly at all convex longitudinally. Mesothorax and scutellum closely and evenly punctured, not shining; anterior area of the propodeum rugose, more strongly so in some examples than in others, sometimes irregularly, sometimes more or less longitudinally. Abdomen dull, impunctate, the apical segments with pale hairs; legs black with silvery pubescence; wings in fresh examples almost or quite clear.

HAB. Coast and lowlands of Molokai, Lanai, and Maui.

OBS. Sometimes examples are taken which have the abdomen more or less of an immature-looking red colour—the so-called 'highly-coloured' varieties of Smith and others. Such individuals are liable to differ also in sculpture and other respects from typical specimens, not only in this, but also in other species.

(31) *Nesoprosopis obscurata*, sp. nov.

Praecedenti simillima, sed ♂ colore flavo tantum anguste supra antennas producto, lamina supraclypeari tota, vel ex parte, nigra, minus elongata, tibiis posticis et intermediis nigris; ♀ capite supra antennas minus dense punctato, inter puncta laeviori, scutello subnitido et laeviori, alis infuscatis, distinguenda. Long. 6—8·5 mm.

Very closely allied to *N. longiceps*, but the ♂ with the head rather less elongate, the plate above the clypeus decidedly wider, and entirely or partly black, the yellow markings of the face only very narrowly produced behind the antennae; the posterior and intermediate tibiae are not pale at the base, the posterior tarsi black or piceo-testaceous; wings more or less distinctly infuscate.

Female, with the head rather less densely punctured above the antennae, than in the preceding, the surface between the punctures smoother and less dull, the scutellum somewhat shining, the wings quite infuscate, and the face somewhat wider.

Hab. Coast or lower slopes of the mountains of Molokai and Lanai; coast of Hawaii (Kealakeakua Bay). Rare.

Obs. I have taken the specimens from Hawaii as types. It is uncertain whether they will prove specifically identical with those from the other islands, but the material taken is insufficient to settle this point.

(32) *Nesoprosopis flavipes*.

Prosopis flavipes, Smith, Cat. Hym. Ins. pt. 1. p. 23; Blackburn and Cameron, P. Manch. Soc. xxv. (1885–86), p. 149.

"Male. Length $2\frac{1}{4}$ lines. Black; the face yellow, the colouring is continued upwards on each side nearly to the vertex of the eye; the scape cylindrical, black, the rest of the antennae orange, yellow beneath. Thorax, the metathorax has no distinctly enclosed space, and is subrugose; the wings hyaline, the nervures dark fuscous, all the tibiae and tarsi bright yellow, the former have a ferruginous stain behind. Abdomen smooth and shining, the margins of the segments narrowly rufotestaceous."

"Hab. Sandwich Islands."

The above description is taken from Smith's work (*l. c. supra*). The species is represented by a single example brought home by the Beechey expedition. Probably it represents on Oahu the *N. finitima* of Kauai, and *N. longiceps* of Molokai, &c. Although very closely allied I believe it to be distinct from either of these species.

(33) *Nesoprosopis finitima*, sp. nov.

N. longicipiti cognata, eodem colore et magnitudine sed mesonoto et scutello subtilius punctatis; ♀ capite etiam minus elongato, et pro longitudine latiore distinguenda. Long. 7 mm.

♂ with the face shaped and coloured as in *N. longiceps*, but with the puncturation of the mesothorax and scutellum distinctly finer; the ♀ is more distinct, the difference between the puncturation of its mesothorax and scutellum and that of *longiceps* being more evident, and its head is evidently shorter and wider.

HAB. Kauai, on the coast at Makaweli in 1894; a single pair only taken. It must be a very scarce species in this and other localities where I searched for it, as I was never able to take another specimen.

(34) *Nesoprosopis anthracina.*

Prosopis anthracina, Smith, Cat. Hym. Ins. I. p. 23.

Prosopis rugiventris, Blackburn and Cameron, P. Manch. Soc. xxv. (1885–86), p. 146.

(Plate II. fig. 17—17 *d*.)

Male, with the clypeus, the plate above it and a spot on each side of it yellow, the greater part of the face in front of the antennae being of this colour; front of the anterior tibiae more or less flavous; legs black, with the tarsi sometimes piceous or testaceous. Head elongate, longer than its width across the eyes, above the antennae dull, rugulose, and shallowly punctured, without any excessively finely and densely punctured area, clothed with short inconspicuous pubescence; scape of the antennae dilated, strongly rounded on its posterior margin, little or not at all on the anterior, evidently but not greatly longer than its greatest width, the front margin viewed from in front deeply arcuate beneath. Thorax and scutellum dull, evenly and closely punctured; propodeum with its anterior area rugose, sometimes rather regularly longitudinally, sometimes quite irregularly, the rugosities much stronger in some individuals than others; seen from in front the rugosities extend to the brow, which is not at all smooth or shining. Abdomen dull, the intermediate ventral segments often raised transversely across the middle; when strongly raised, then generally the surface is smoother and more shining, but extremely variable in this respect; process of the eighth ventral segment not much dilated dorso-ventrally, the apex bifurcate and fringed with long hairs.

Female, black, with only the flagellum of the antennae beneath, and the front of the anterior tibiae pale. It closely resembles the ♂ in form and sculpture; the clypeus is slightly emarginate at its apex; the head above the antennae quite dull and rugulose, shallowly punctured as in the ♂. Scutellum dull, rugulose between the punctures, which are close and even. Abdomen dull, the apical segments with dark hairs. Wings in both sexes clear, or clouded across the middle. Length 5·5—7·5 mm.

HAB. Coast and lowlands of Molokai, Lanai, and Maui; abundant. Oahu (Honolulu and Waianae); Kealakeakua Bay, Hawaii.

OBS. Most of the examples (♂) from the intermediate islands have the ventral segments transversely ridged more or less strongly, but in some the ridges are obsolete, and then the surface is generally duller and more or less evidently punctured; Oahuan specimens are generally of the latter form, but sometimes the ridges are quite strongly developed. The ♂ is quite distinct from any other except the slightly modified form next described, although its general appearance is extremely similar to that of *N. facilis* and others. The ♀ is very like that of *N. longiceps* and *blackburni*, to which it is really closely allied, but the much less densely punctured head behind the antennae will easily separate it from the former; the longer face, and the duller and more closely punctured scutellum, from the latter.

(35) *Nesoprosopis flavifrons.*

Prosopis flavifrons, Kirby, Ent. Mo. Mag. XVII. p. 85. Blackburn and Cameron, P. Manch. Soc. XXV. (1885–86), p. 144.

(Plate II. fig. 18—18 *b*.)

Male, like the preceding in general form and colour; scape of the antennae often with the anterior margin more or less pale, and evidently more strongly dilated than that of *N. anthracina*, subcordiform in shape, the anterior margin distinctly rounded as well as the posterior; the face is also rather wider, and the eighth ventral segment has the process rather strongly dilated. I see no character whereby the females of the two forms can be separated. Length 5·5—7·5 mm.

HAB. Coast of Kauai, not rare; many males were taken in January, 1897, but only two or three females. I have seen cells of this species formed in dead twigs.

(36) *Nesoprosopis assimulans*, sp. nov.

N. obscuratae cognata, et colore simillima; ♂ antennarum articulo primo magis dilatato, margine posteriore fortius rotundato; ♀ mesonoto subtilius punctato bene distincta. Long. 6·75—9·5 mm.

(Plate II. fig. 19—19 *b*.)

Male, with the greater part (often nearly the whole) of the clypeus, and a large subtriangular mark on either side of it which reaches as high, or a little higher than the line of insertion of the antennae, yellow; the lateral triangles are always divided from the yellow of the clypeus by more or less narrow black lines; the plate above the clypeus is entirely black. In form the species is very like *N. obscurata*, but the following characters will easily distinguish it. Male with the scape of the antennae evidently more strongly dilated, its posterior margin more strongly rounded; punctuation of the mesothorax and scutellum rather finer, these parts being very dull, with very close and shallow punctures. The ♀ may be known at once by the exceedingly minute shallow puncturation of the mesothorax, that of the scutellum being only slightly more distinct, and the surface of both quite dull. Wings more or less distinctly clouded, especially across the middle portion.

Hab. Mountains of Lanai (2000 ft.) and on the coast at Awalua. Wailuku, Maui on the sandhills, and at Lahaina. Not common.

Nesoprosopis assimulans var. *oahuensis*, var. nov.

♂ maculis flavis minoribus, ♀ alis fortiter infuscatis distinguenda.

Agrees with the former in structure, but the ♂ has the yellow markings of the face often much reduced in size, and the wings generally darker; ♀ with the wings entirely infuscate, and in certain lights with a distinct steely iridescence.

Hab. Waialua and Waianae (Oahu), on the coast, or a few hundred feet above sea-level.

(37) *Nesoprosopis inquilina*, sp. nov.

Nigra, opaca, griseo-pubescens, alis hyalinis; ♂ clypeo fere toto, maculisque duabus triangularibus extra clypeum, late supra antennas productis, flavis; lamina supraclypeari tota, vel ex majore parte, nigra; antennarum articulo primo fortius dilatato, apice antice producto; ♀ capite nigro, trans oculos lato, mesonoto opaco, levissime punctato; tarsis anterioribus pilis brevioribus, vix curvatis, vestitis. Long. 7 mm.

Male, with the clypeus almost entirely, and the sides of the face between it and the eyes, yellow; the latter markings produced rather widely above the antennae along the margin of the eyes; plate above the clypeus entirely or almost entirely black; anterior tibiae and tarsi pale in front; tibiae of the intermediate and posterior legs sometimes with a yellow spot at the extreme base, and slightly pale at the apex, their tarsi black or piceous.

Face much shorter and wider than that of *N. longiceps*, the scape of the antennae somewhat strongly dilated, and of peculiar form, as its anterior apical angle is somewhat produced; head above the antennae closely, subrugosely and very shallowly punctured. Mesothorax dull, with grey pubescence, and very shallow ill-defined puncturation; the scutellum with very similar sculpture; propodeum with the anterior area entirely dull, rugose to the brow. Abdomen dull, with rugulose surface; the first, second, and third segments with a short fringe of pale decumbent hairs, at least at the sides, but these bands are very easily abraded; process of the eighth ventral segment dilated, and densely clothed with long hairs on the ventral side, and the apical bifurcation fringed. Wings clear in fresh specimens.

Female, black, with the anterior tibiae testaceous in front. The face is wide across the eyes, in certain positions appearing even transverse; the apex of the clypeus slightly emarginate; head above the antennae quite dull, and shallowly punctured. Mesothorax dull, with fine, indefinite punctures, these being very shallow, and the general surface rugulose; scutellum also dull and similarly punctured; propodeum as in the ♂. Abdomen dull, the apical margins of the segments widely pale, apical segments with pale hairs; front legs with the intermediate joints of the tarsi with somewhat short hairs, quite different from the long, curved, and regularly disposed ones of all the preceding species.

Hab. Kilauea, Hawaii (4000 ft.). Very rare. I took a ♂ and ♀ in company in December, 1896, and a single ♂ on each of two previous visits to the same locality. The ♀ is somewhat abraded and shows no trace of lateral pubescent streaks, but I suspect they would be present in a fresh example.

Obs. This and the four following species are parasitic on certain of the species already described. The females are easily known from those of the industrial forms by the degeneration of the sweeping hairs on the front tarsi. The males however seem to show no important points of distinction.

(38) *Nesoprosopis hilaris*, Sm.

Prosopis hilaris, Smith, J. Linn. Soc. xiv. p. 683. Blackburn and Cameron, P. Manch. Soc. xxv. (1885–86), p. 147.

Male, with the whole face below the antennae bright yellow, and this colouring is produced above the line of insertion of the antennae broadly along the border of the eyes; mandibles ferruginous with a yellow line; scape of the antennae yellow on the anterior half of its dilated surface, fulvous on the posterior; abdomen with the basal segments ferruginous. Antennae with the scape dilated, evidently longer than wide, but not nearly twice as long; head above the antennae dull, somewhat rugosely punctured. Mesothorax with grey pubescence, dull, and evenly punctured; scutellum with similar sculpture; propodeum rugose to the brow; apical segments of the abdomen with narrow fasciae of white pubescence along their apical margins; all the tibiae and tarsi fulvous.

Female, like the ♂ in sculpture, cheeks, clypeus and the face at the sides, as well as the antennae, more or less red; the clypeus distinctly emarginate at its apex; the face wide across the eyes; intermediate tibiae almost entirely pale, their apex only narrowly fuscous, the posterior widely pale at the base, their apical half generally more or less fuscous; the intermediate and posterior trochanters both red or pale; wings in both sexes clear. Length, 5—8 mm.

HAB. The sandy Isthmus between East and West Maui; also found on the coast of Lanai at Manele. In both cases the closely allied species *N. volatilis* Sm. is found with it, but apparently that species alone frequents the neighbouring island of Molokai, as the present species was not found there. *N. volatilis* extends its range far up the mountains—as high as eight or nine thousand feet—but *N. hilaris* is confined to sandy localities near the coast. Individuals vary greatly in size; on Maui the small examples breed in the cells of *N. blackburni* and probably of *N. anthracina*, the large ones in the cells of *N. assimulans*. The delicate fringe of white pubescence on the apical margins of the apical segments is very easily destroyed, but the present species could easily be distinguished from *N. volatilis* by this character, as they flew together over the sand.

(39) *Nesoprosopis hostilis*, sp. nov.

Praecedenti forma et colore simillima; segmentis abdominis apicalibus pubescentia haud fasciatis; ♂ articulo primo antennarum antice pallido, postice nigro; tibiis posterioribus et intermediis basi anguste pallidis; ♀ capite flavis duabus maculis juxta oculos ornato, tibiis posterioribus basi anguste flavis distinguenda. Long. 5—6 mm. (Plate II. fig. 4, also fig. 20—20*b*.)

Very closely allied to the preceding species, from which it seems hardly to differ in sculpture, although it is a rather more shining insect than any of the other parasitic species.

Male, with the face coloured as in *N. hilaris*, the yellow markings being produced behind the antennae rather broadly along the borders of the eyes; mandibles without a yellow line; scape of the antennae with the upper surface pale only on its anterior part, the posterior being black or nearly so; intermediate and posterior tibiae dark, pale at the base outwardly for only a short distance.

Female, with a yellow (generally triangular) spot on each side of the face, surrounded by reddish colour, with which they gradually become blended; the legs coloured much as in the ♂. The range of colour in the ♀ is quite different from that of the allied species, the prothorax, the mesothorax at the sides and the propodeum wholly or in part being generally red or reddish.

HAB. Mountains of Kauai (3000—4000 ft.) in various localities. Parasitic on *N. laeta*, and probably other species.

(40) *Nesoprosopis volatilis.*

Prosopis volatilis, Smith, J. Linn. Soc. XIV. p. 683. Blackburn and Cameron, P. Manch. Soc. XXV. (1885-86), p. 148.

Closely allied to *N. hostilis* but duller. In the ♂ the yellow colour is less widely produced along the eyes behind the antennae; the scape of the antennae is coloured like that of *N. hostilis*, but the pale colour is often much diminished, and sometimes absent in Oahuan specimens, which are in general duller, and have the yellow markings more clouded, or reduced in size, than examples from Molokai and Lanai. The ♀ has the face below the antennae red without yellow markings; the intermediate and posterior trochanters are of an obscure colour, or quite black. The wings in both sexes are less clear than those of *N. hilaris*, and the margins of the abdominal segments are without a fringe of pubescence. Length 5—8·5 mm.

HAB. Oahu, Lanai, Molokai and Maui, both on the coast and in the mountains —as high up as 8000 ft. on Haleakala. I have taken remarkably large specimens at Waianae, Oahu, in company with *N. assimulans var. oahuensis*—a large species—on which no doubt they were parasitic. It also attacks *N. facilis*, *N. difficilis*, and other species.

(41) *Nesoprosopis sphecodoides*, sp. nov.

Praecedentibus affinis, ♂ abdomine toto nigro, vel nonnunquam segmento basali plus minusve obscure rufo vel piceo, antennarum articulo primo nigro; ♀ capite prae antennis toto nigro distinguenda. Long. 5—7 mm.

Male, with the abdomen entirely black, or with the basal segment sometimes more or less obscurely reddish; clypeus with a yellow spot extending from its base to about three-fourths of its whole length, and outside it there is a triangular spot on each side of the face; these spots are separated by more or less black between them, and they are variable themselves, being much reduced in size in some examples; scape of the antennae entirely black. Superficially the ♂ bears a close resemblance to some of the non-parasitic species, but the inconspicuous pubescence of the front of the head above the antennae, the closely punctured scutellum, and the propodeum, which is rugose right up to the brow, will generally distinguish it. The ♀ is black with the basal and more or less of the second segment of the abdomen ferruginous; the face is entirely black, the clypeus at the most showing a slight tinge of obscure red; posterior and intermediate tibiae black or of an obscure colour.

HAB. Hawaii, both sides of the island, at an elevation of 4000 ft. Parasitic on *N. difficilis* and probably other species.

OBS. The five parasitic species above described are extremely closely allied to one another, but I believe them to be sufficiently distinct. They all agree in having the vertex of the head somewhat incrassate, the scutellum closely and evenly punctured, the propodeum rugose to the brow, and the head between the antennae and the vertex with only an inconspicuous pubescence, the latter character being characteristic of the *blackburni* group of non-parasitic species, to which I believe these are closely allied. The males (except *N. inquilina*) all have the scape similarly formed; the females have the apex of the clypeus distinctly emarginate, and the sweeping hairs of the anterior tarsi in an evidently degraded condition.

(42) *Nesoprosopis fuscipennis.*

Prosopis fuscipennis, Smith, J. Linn. Soc. XIV. p. 682. Blackburn and Cameron, P. Manch. Soc. XXV. (1885–86), p. 140.

A very large species, the ♂ with the face black, deeply depressed along the eyes, the depressions dull; clypeus with shallow punctures, and a few hairs along the apical margin. Scape of the antennae strongly dilated, closely and finely punctured, both front and hind margins rounded, the latter much the more strongly, the former with a white line, seen from in front the front margin is very strongly arcuate beneath; head above the antennae with shallow punctures. Prothorax with a whitish band posteriorly; mesothorax dull and punctured, the punctures slightly wider apart and larger posteriorly; scutellum with larger and less shallow punctures, depressed from the sides to the middle line; propodeum with the anterior area more or less strongly irregularly rugose. Legs with the apical joints of the tarsi usually clear testaceous, sometimes however entirely obscure; posterior tibiae with a white line beneath at the base, the posterior metatarsi also generally with a short basal streak, but this is sometimes absent. Basal segment of the abdomen with scattered punctures, second and following with very distinct though shallow puncturation; beneath shining, rather largely and shallowly punctured.

Female, very like the ♂, apart from sexual differences. The prothorax is similarly banded, and the posterior legs are marked in the same way; the tarsi are often without the white streak, their apical joints are generally pale, but sometimes dark. Apical segments of the abdomen generally with bright brown hairs, but sometimes these are of an obscure colour. Length, 8—11 mm.

Nesoprosopis fuscipennis, var. *obscuripes*, var. nov.

Tarsi all dark, and the wings, especially beneath, with a violet iridescence ; pubescence of the apical segments of the abdomen of the ♀ usually darker than in typical examples.

HAB. Mountains of Oahu, both ranges. Mountains of West Maui, var. *obscuripes*.

OBS. This and most of the following species are remarkable for their great size, and the very evident puncturation of the abdomen. The examples taken on Maui appear to be always of the var. *obscuripes* ; some of the Oahuan specimens are hardly separable from these, while others with shining fuscous wings without iridescence, and pale tarsi, have a distinct appearance.

(43) *Nesoprosopis caeruleipennis*, sp. nov.

Praecedenti simillima, pronoto postice albo-marginato, tarsis infuscatis, alis laete caeruleo-iridescentibus. Long. 8—11 mm.

Hardly differs in structure, so far as I can see, from the preceding, but the dark wings with light blue iridescence on both surfaces, give it a very distinct appearance. The pale markings are like those of *N. fuscipennis*, those on the legs are variable. The apical segments are clothed above and beneath with more or less obscurely-coloured pubescence, and the tarsi are dark.

HAB. Mountains of Molokai and Lanai, from two to four thousand feet. Many examples taken, and a variety of both ♂ and ♀ on Molokai with the abdomen more or less reddish.

(44) *Nesoprosopis pubescens*, sp. nov.

Praecedentibus simillima, abdomine magis pubescente, pronoto postice nigro, rarius albo-marginato, segmento secundo ventrali a basi magis elevato, saepe subtuberculato; alis fuscis; ♀ abdominis segmentis apicalibus pallide pubescentibus. Long. 8—11 mm. (Plate II. fig. 21—21 *c*.)

Prothorax generally black, sometimes with a much broken white band on the posterior margin or faint indications of such, very rarely the ♂ has an entire band. The legs are variable in colour, in some examples almost the whole of the posterior metatarsi are white. The wings in the ♀ are shining fuscous, generally also in the ♂, but in one of these they show a distinct blue iridescence. The prothorax in the ♀ appears never to have an entire pale band, its abdomen is decidedly more pubescent and rather more punctured than in the allied species, and the second ventral segment is more strongly raised from the base, having in some specimens a tuberculate form.

HAB. Mountains of Hawaii from 2000—4000 ft. in various localities (Kona, Puna, and Kau). Not rare.

(45) *Nesoprosopis setosifrons*, sp. nov.

Nigra, alis fuscis caeruleo-iridescentibus; clypeo breviter nigro-setoso; scutello vix depresso, aequaliter punctato; ♂ pronoto nigro, nonnunquam postice albo-lineato, antennarum articulo primo nigro atque dilatato, evidenter longiore quam latiore; capite prae antennis utrinque, nonnunquam etiam clypeo, albo-maculato; tibiis posticis albo-lineatis; ♀ segmentis abdominis apicalibus pilis nigricantibus vestitis. Long. 7·5—10·5 mm. (Plate II. fig. 22—22 *c*.)

Male, with a large white spot on each side of the face below the antennae, and sometimes one near the apex of the clypeus; the hind margin of the prothorax rarely with a white band; posterior and intermediate tibiae with a pale line from the base, of variable length, sometimes reaching to their apex; basal joint of the tarsi with a spot at their base; sometimes however the legs are entirely dark, except the front of the anterior tibiae. Scape of the antennae black, without a white line on its front margin, dilated, its hind margin strongly rounded, its front one very slightly so, considerably longer than wide; clypeus with short erect black hairs (easily seen in lateral view); the face not deeply grooved at the sides along the eyes, above the antennae clothed with black hairs. Mesothorax and scutellum with dark pubescence, and shallowly punctured, the latter not depressed from the sides to the middle line; anterior area of the propodeum rugose, more strongly so in some examples than in others. Abdomen subelongate, evidently, but very shallowly, punctured; apical segments with dark pubescence; eighth ventral segment with the process dilated for about half its length, the dilatation of triangular shape, fringed on the ventral edge with long hairs, as also the terminal bifurcation.

Female, like the ♂ in general sculpture, but more robust. Face rather strongly convex longitudinally; clypeus with black bristly hairs. Prothorax always with a white margin; all the tibiae above white, or with a white line, beneath dark, except at the base; basal joint of the posterior tarsi with a white line. Abdomen shining with shallow and by no means close puncturation; second and third segments at the sides without indications of pale pubescence; apical segments with black hairs. Wings in both sexes entirely dusky, with steely-blue iridescence.

HAB. Mountains of Hawaii (4000 ft.). Kona district and at Kilauea. The ♂ is easily known from any of the preceding large species by the form of the scape of the antennae, which is less strongly arched beneath, and the less strongly dilated process of the eighth ventral segment, while the black-haired clypeus, the steely iridescence of the wings, and the less pubescent and less punctured abdomen, will distinguish either sex. Generally taken from flowers of *Metrosiderus*, *Rubus*, and sandal trees, and from burrows in the trunks of the latter. The single ♂ taken in Kona is the only one with the white-bordered prothorax, and it also has a large white spot on the clypeus. The ♀♀ taken there do not differ from the Kilauea specimens. The latter sex appears to be much more constant in colour than the former.

(46) *Nesoprosopis perspicua*, sp. nov.

Praecedenti affinis, pronoto latissime albo-fasciato, tibiis posticis (macula nigra apicali excepta) albidis; alis peropacis, nigricantibus; clypeo minus pubescente; ♂ capite toto nigro, antennarum articulo basali antice albo-marginato, bene distinguenda. Long. 8—9·5 mm. (Plate II. fig. 5.)

Closely allied to the preceding, but easily distinguished by the very wide creamy-white collar, and the posterior tibiae almost entirely of the same colour, being black only at the apex within. The wings are very dark, with steely iridescence. The posterior metatarsi are black, sometimes with a small white spot at the base. The ♂ has the face entirely black, but the anterior margin of the scape of the antennae is white. The eighth ventral segment is dilated much as in the preceding species. In both sexes the thorax is clothed with short inconspicuous pale pubescence, while in *N. setosifrons* it is longer and black.

Hab. Mountains of Kauai about 3000 ft. (January, 1897). A nice series were taken all from the flowers of a single tree (a species of *Straussia*), but only one of these was a ♂.

(47) *Nesoprosopis satelles*

Prosopis satelles, Blackburn, P. Manch. Soc. xxv. (1885–86), p. 141.

(Plate II. fig. 23—23 *d.*)

Male, with the face entirely black, or with the clypeus tinged with red, or brightly red, as also sometimes the plate above it; scape of the antennae entirely black or with the anterior margin red. The face is wide across the eyes, and its sides along their borders deeply depressed, the depressions extending behind the line of insertion of the antennae. Scape of the antennae greatly dilated, not longer than wide, distinctly and very closely and finely punctured, both front and hind margins strongly rounded, beneath deeply arcuate. Mesothorax and scutellum with dark pubescence, distinctly and evenly punctured; propodeum with the anterior area more or less rugose in front, behind these rugosities its surface merely rugulose, sometimes the whole area rugulose. Abdomen subelongate, with a fine and shallow, but quite distinct puncturation, even on the basal segment; eighth ventral segment with its process exceedingly strongly dilated, the dilated part with a pale membranous appearance, its ventral crest densely clothed with generally sooty-black hairs, the extremity bifurcate and greatly dilated, fringed with long pubescence. Posterior tarsi sometimes testaceous, sometimes dark.

Female very like the ♂, but more robust, the clypeus and sometimes the plate above it and the scape of the antennae (more or less) red. Face strongly convex longitudinally, above the antennae generally finely strigose and punctured, clothed with dark pubescence. Prothorax black, as in the ♂, and the mesothorax and scutellum similarly punctured; propodeum with the rugosity of its anterior area extremely short, sometimes almost absent, the surface finely rugulose. Abdomen with the basal segments shining, the first distinctly, though finely and shallowly punctured, somewhat closely towards the apex; second segment very finely punctured on the basal half; the following segments with rather larger, but very shallow puncturation; apical segments with black hairs. Wings entirely dark in both sexes, and with blue iridescence. Length, 8—10 mm.

Hab. Mountains of Molokai and Lanai, and on Haleakala, Maui (5000 ft.). The males from Molokai generally have the face entirely black, or with the clypeus only obscurely reddish towards the apex. On Lanai they apparently always have the clypeus and anterior margin of the scape of the antennae pale. Two examples from Molokai resemble those from Lanai. Specimens from the latter island are of smaller average size than those from the former. On Maui I have only taken the ♀.

(48) *Nesoprosopis insignis*, sp. nov.

Praecedenti finitima, ♂ articulo primo antennarum fortiter transverso marginibus ambobus fortissime rotundatis; ♀ clypeo nigro distinguenda. Long. 8—9·5 mm. (Plate II. fig. 24.)

Like the preceding in general form and sculpture, but the ♂ with the scape still more strongly dilated, it being strongly transverse, both front and hind margin exceedingly strongly rounded. The facial markings are evidently variable, one of the two examples taken having the face entirely black, the other with a broad longitudinal yellow band, expanded at the apex, down the middle of the clypeus. In one the sides of the face are very deeply grooved, in the other much less so. Thorax and abdomen much as in *N. satelles*.

Female, face entirely black. Scutellum very dull, and very shallowly punctured; anterior area of the propodeum more rugose than that of *satelles*. Apical segments of the abdomen with a very faint aeneous tint in some lights, and clothed with dark pubescence. Wings dark, with blue iridescence.

HAB. Kilauea, Hawaii (4000 ft.). Two pair were taken, but neither in very good condition. When fresh, the ♀ probably has fairly distinct apical pubescent bands on the basal segments.

(49) *Nesoprosopis andrenoides*, sp. nov.

♀ praecedentis forma: propodei area antica clathrate-rugosa; abdomine laevissimo, subtilissime sparsim punctato, aeneo-micante, segmentis tribus basalibus postice pulchre albido-fasciatis (fascia prima interrupta), bene distincta. Long. 9·5—10 mm. (Plate II. fig. 6.)

Female, black, very like the preceding in shape. Mesothorax and scutellum quite dull, and distinctly punctured; anterior area of the propodeum entirely clathrately-rugose. Abdomen with the surface very smooth, sparsely and very finely punctured, black with a distinct aeneous or bluish tint; the first, second and third segments with beautiful fasciae of pale decumbent hairs on their apical margins, the first widely interrupted, apical segments with black hairs, beneath finely but distinctly punctured. Legs black (except that the anterior tibiae in front are sometimes more or less pale), with black pubescence. Wings dark, with blue iridescence.

HAB. Mountains of Kauai (2000—3000 ft.). Four females of this beautiful species were taken from the flowers of *Metrosideros*.

(50) *Nesoprosopis paradoxica*, sp. nov.

Grandis et robusta, nigra, griseo-pubescens, propodeo antice rugoso, abdomine rufo (♀ rufo-nigro), distincte punctato; alis fuscis, supra aeneo-micantibus, subtus caeruleo-iridescentibus; ♂ antennarum articulo primo fortiter dilatato, sed haud latiore quam longiore, margine antico saepe plus minusve pallido, subtus fortiter arcuato; clypeo depresso; abdomine supra nigro-pubescente. Long. 9·5—11·5 mm. (Plate II. fig. 7, also fig. 25 and 25 *a*.)

Male, with the face entirely black, scape of the antennae sometimes with a pale line in front. The face is not deeply depressed at the sides, but the depression extends over the greater part of the clypeus; the scape of the antennae dilated, not much less wide than long, clothed with long pale hairs, its front and hind margins both rounded, beneath deeply arched. Thorax and scutellum with grey pubescence, and distinctly punctured, the latter depressed from the sides to the middle line; propodeum rugose in front. Abdomen red, with the basal segments shining, distinctly punctured, and clothed rather densely, especially on the third and following segments, with short black hairs; eighth ventral segment with the apical portion of its process hardly dilated, the terminal bifurcation fringed with dense long hairs.

Female, like the ♂, but more robust; face not very strongly convex longitudinally; scutellum dull, closely and evenly punctured; anterior area of the propodeum irregularly rugose. Abdomen shining, distinctly punctured, the basal segment red, more or less obscured, the rest reddish-black; second ventral segment simple, somewhat strongly and evenly punctured, the following segments more closely, the apical ones clothed with black hairs.

Wings in both sexes fuscous with blue iridescence beneath, and a bronzy glitter above.

HAB. Kona, Hawaii (4000 ft.). Not common. Taken while entering burrows in dead trunks of *Sophora*. It is an industrial species, though the ferruginous abdomen reminds one of most of the parasitic forms. This colour and the great size distinguish it at a glance from all but the following species.

(51) *Nesoprosopis erythrodemas*, sp. nov.

♀ praecedenti simillima, nigra, abdomine toto rufo; capite longitudinaliter magis convexo; propodeo, a fronte viso, acutius postice rotundato, sparsim longitudinaliter rugoso; abdominis segmento secundo ventrali minus nitido, subtilius punctato, et a basi fortiter elevato, distinguenda. Long. 10 mm.

Female, very like the preceding, but somewhat less robust; the face strongly convex longitudinally; the propodeum seen from in front sharply rounded behind, bearing a few longitudinal wrinkles. Abdomen entirely red, with the second segment more sparsely punctured above, beneath very strongly raised from the base to near the apex, and less shining and more finely punctured than that of *paradoxica*.

HAB. Kilauea, Hawaii (4000 ft.). Very rare, a single ♀ only taken, but had I supposed it to be distinct from the preceding at the time of capture, others probably might have been found.

(52) *Nesoprosopis anomala*, sp. nov.

♀ minor, capite, oculis exceptis, rubro; pronoto postice albido-marginato; mesonoto densissime punctato, pubescentia pallida vestito; propodei area antica glabra, subnitida, clathrate-rugosa, lateribus et parte posteriore dense pubescentibus; abdomine ad basim rubro, postice rufo-nigro, distincte punctato; tibiis rufis, supra albo-lineatis. Long. 7·5 mm.

Female robust, but not very large; head entirely red except the eyes, closely and rugosely punctured above the antennae, the pubescence pale. Thorax black, prothorax with a whitish posterior margin; tegulae testaceous with a yellow spot; mesothorax excessively densely and shallowly punctured, the disc glabrous, but all the margins clothed with pale fulvous pubescence, as also the whole of the scutellum, postscutellum, and propodeum, except the anterior area of the latter, which is quite hairless, and rather strongly clathrately-rugose and shining. Abdomen shining, the base red, the rest blackish, but more or less tinged with red; second and following segments distinctly punctured, apical segments with black hairs. All the legs red, the tibiae with a yellow line above: wings fuscous with very little iridescence.

Hab. Mountains near Honolulu. A single ♀ taken on the blossoms of *Acacia koa*. Allied to *N. setosifrons* and *perspicua*, this remarkable species in general appearance is quite unlike any other.

Acutilingues.

Apidae.

(1) *Xylocopa aeneipennis.*

Xylocopa aeneipennis, de Geer, Mémoires, III. p. 573, tab. 28, fig. 8. Smith, J. Linn. Soc. XIV. p. 684.

Hab. Abundant on the lowlands, but not found far up the mountains.

(1) *Megachile diligens.*

Megachile diligens, Smith, l. c. supra.

Hab. Oahu, Molokai, Kona district of Hawaii; not in the mountains. Rare. Blackburn says 'not uncommon,' and I suspect the species is rarer now than it was twenty years ago. It may be an endemic species, while the two following are certainly introduced, and are now abundant on most of the islands. Had they occurred in the islands formerly, Mr Blackburn would certainly have met with them, as they are common around the houses in Honolulu. I have not identified either from elsewhere, and do not know whence they were imported.

(2) *Megachile schauinslandi.*

Megachile schauinslandi, Alfken, Ent. Nachr. XXIV. (1898), p. 340.

Niger, thorace abdominisque segmento primo pubescentia fulva breviter denseque vestitis, segmentis caeteris utrinque macula pubescente albida ornatis, alis infuscatis, caeruleo-iridescentibus, scopa ♀ pallida. Long. 9—11·5 mm.

Black, the thorax and basal segment of the abdomen densely clothed with short fulvous pubescence.

Male: clypeus fringed with long pale hairs in front, otherwise shining, coarsely and closely punctured, and sparsely clothed with erect black hairs. Head above the clypeus with pale hairs, becoming fulvous about the insertion of the antennae. Thorax with short dense fulvous hairs, becoming longer at the sides of the propodeum. Anterior tarsi simple, the basal joint three or four times as long as wide. Wings and nervures fulvescent at the base, deeply infuscate over more than the apical half, and with a blue iridescence. Abdomen somewhat shining, coarsely punctured, the puncturation becoming less distinct on the apical segments, basal segment densely clothed with fulvous hairs, the following with inconspicuous black ones, and each with a small spot of white pubescence on either side along the apical margin, the second and third deeply impressed at the base, sixth with its apical crest slightly emarginate, and deeply foveolated before the crest. Ventral segments very densely punctured, clothed with appressed white pubescence, and each of the four visible ones with an entire apical fascia of longer and denser appressed hairs.

Female like the ♂ in general appearance but larger, the clypeus without the pale fringe and its puncturation excessively dense. Mandibles dull, rugose and punctured, flattened in front. Ventral scopa of silvery hairs, those on the apical segment black.

Hab. Several and probably all of the islands in and around settlements, often making its *nidus* in holes in woodwork, keyholes, &c. Very abundant in Honolulu.

Obs. I have had this species described for some years under the name of *M. domesticum* in MSS. awaiting publication, and have given it away under this name.

(3) *Megachile palmarum*, sp. nov.

Niger, cinereo-pubescens, abdomine ♂ 4, ♀ 5, fasciis pubescentiae pallidae ornato, alis subhyalinis, segmento sexto ♂ profunde emarginato, scopa ventrali ♀ pallida. Long. 9—10 mm.

Male: face densely clothed with pale fulvous pubescence to above the insertion of the antennae, the vertex almost bare and very densely punctured. Thorax finely and very densely punctured, sparsely clothed with pale pubescence. Wings subhyaline. Front tarsi simple. Abdomen densely punctured, the first four segments with a narrow entire apical band of pale pubescence, sixth with the apical crest deeply emarginate, and having a spot of appressed pubescence before the crest; beneath with four segments exposed, the second and third with an entire apical band of pale pubescence, the apical margin of the fourth sinuate; 5th submembranous, with a semilunar impressed area, which is notched in the middle of its apical margin, and appears to be densely covered with minute asperities (under the microscope these apparent asperities are seen to consist in reality of peculiar short thick hairs with knobbed apices); 6th band-like and fragile, with a transverse line of remarkable hairs, which are flattened and curved, with their apices bent and acuminate; 8th very delicate, tongue-like, obtuse at the apex; genital armature with the *stipites* and *sagittae* of equal length, the latter connected by membrane to their apex, the former flattened, widening towards the apex, and there pointed, bent outwards, and set with a few extremely short hairs. Calcaria pale.

Female very like the ♂ in general appearance. The pubescence is cinereous with little or no fulvous tinge, that on the clypeus is sparse, so that the puncturation is exposed. The first five abdominal segments have a band of pale pubescence, beneath the scopa is formed of silvery hairs, those on the apical segment black.

HAB. Several and probably all the islands, especially about towns or settlements. Nests frequently in the leaves of coconut and other palms when they have been rolled up by the larva of a Pyralid.

(1) *Apis mellifica.*

Apis mellifica, Linn. Syst. Nat. ed. x. i. p. 576.

HAB. The hive bee is common throughout the islands, and is now found wild in many of the mountain forests, forming its nests in hollow trees.

HETEROGYNA.

(FORMICIDAE.)

Par Aug. Forel.

(1) *Ponera kalakauae*, nov. spec.

☿. L. 2·8 à 3 mill. Rapprochée de la *P. coarctata*, mais les mandibules plus courtes, plus larges, à bord externe moins convexe, n'ont à la partie postérieure de leur bord terminal que de deux à quatre dents très obtuses, indistinctes, mais assez larges, au lieu des petites denticulations serrées de la *P. coarctata*. L'épistome est plus court, bien plus concave de chaque côté de son bord antérieur, à convexité centrale plus forte. Le 1^{er} article du funicule est plus grêle, long comme les trois suivants réunis (ces derniers très courts); chez la coarctata et congénères, il est plus court. Les yeux ont de 7 à 8 facettes et sont assez près du bord antérieur. Tête rectangulaire allongée, à côtés très faiblement convexes. Le sillon frontal atteint presque l'occiput. Le mésonotum, vu de dessus, est presque circulaire, à peu près aussi long que le pronotum. La face basale du métanotum, à peine plus longue que le mésonotum, aussi longue que la face déclive, est notablement plus large derrière que devant (ses deux côtés convergent très distinctement en avant); elle forme un angle subitement arrondi, mais approchant de l'angle droit, avec la face déclive qui est plane. Le pronotum est très convexe devant, mais le reste du dos du thorax est subdéprimé, presque plan, très faiblement biincisé aux sutures. L'écaille est épaisse comme chez l'*eduardi* (plus épaisse que chez la *trigona*, plus mince que chez la *coarctata*), mais bien plus basse, dépassant à peine le thorax et l'abdomen. Abdomen distinctement, mais modérément rétréci après le 1^{er} segment; le second plus large.

Luisante; ponctuation bien plus fine, moins dense et moins profonde que chez la *coarctata*. La pilosité et la pubescence sont aussi plus fines et plus espacées.

D'un brun jaunâtre sale, avec le front, l'occiput et l'abdomen (sauf le premier segment et l'extrémité) bruns. Le pronotum et le mésonotum sont plus foncés que le métanotum et l'écaille qui sont plutôt d'un jaune brunâtre, comme les pattes, les antennes et les mandibules; tarses jaunâtres.

♀. L. 3·5 mill. La suture entre le scutellum et le métanotum très profonde; ce dernier assez long, bien séparé par une incisure distincte du reste du thorax, sans que ses côtés convergent en avant; une courbe très arrondie entre les deux faces du métanotum. Ailes courtes, hyalines, dépassant à peine l'abdomen.

Pattes, antennes, mandibules, extrémité de l'abdomen d'un jaune brunâtre plus ou moins foncé; cuisses brunes au milieu. Epistome, scutellum, écaille et bord des segments abdominaux d'un brun rougeâtre; le reste d'un brun foncé. Du reste comme l'ouvrière.

La forme du thorax, les mandibules etc. me semblent justifier la fondation d'une espèce, malgré le dédale déjà si compliqué du groupe *coarctata* auquel cette forme appartient.

HAB. Lihue, Kauai, ☿; the winged ♀ taken in the town at Honolulu.

(2) *Ponera perkinsi*, nov. spec.

☿. Extrêmement semblable d'aspect à l'*opaciceps* type, mais les pattes et les antennes sont plus courtes, les articles du funicule sont plus larges et plus courts (les art. 3 et 4 deux fois plus larges que longs); les dents des mandibules sont encore plus larges et plus espacées, les yeux un peu plus petits, le thorax plus convexe et la sculpture un peu moins dense et moins mate.

Les scapes atteignent le bord occipital. L'angle métanotal est un peu plus arrondi, et tout le thorax un peu plus trapu (face basale du métanotum plus courte), l'écaille aussi moins haute.

Tout cet ensemble de différences la rapproche de la *P. coarctata*, dont elle diffère par sa taille bien plus robuste et plus large, sa tête à côtés convexes, ses yeux distincts.

D'après M. Perkins, cette espèce, répandue à l'intérieur de toutes les îles Hawai, doit être la seule forme bien certainement locale de l'archipel. Je crois donc que, malgré ses affinités avec l'*opaciceps*, il vaut mieux en faire une espèce. Elle varie de couleur jusqu'au rougeâtre.

Un exemplaire de l'ouvrière a des yeux à facettes assez gros, sans être du reste notablement plus grand que les autres, ni différent à d'autres égards. C'est donc exactement le même cas que celui de la *Ponera eduardi* Forel, récoltée par moi dans la Province d'Oran; mais chez cette dernière les individus oculés sont distinctement plus grands.

♀. L. 3·7 mill. Ailes hyalines, courtes; nervures et tache marginale pâles. Face basale du métanotum courte, sans trace d'incisure à ses sutures, passant en avant aux autres pièces par les mêmes surfaces, mais abruptement tronquée derrière par la face déclive. Du reste comme l'ouvrière, avec les différences ordinaires du polymorphisme sexuel. D'un noir brunâtre; mandibules rouges; pattes et antennes d'un brun rougeâtre. Echancrure de l'abdomen faible.

♂. L. 3 mill. Tête presque carrée, à angles postérieurs arrondis. Les yeux occupent un peu plus de la moitié antérieure des côtés. Scapes un peu plus courtes que le 2^me^ art. des funicules. Face basale du métanotum extrêmement courte, face déclive en talus. Abdomen pas ou presque pas rétréci après le 1^er^ segment. Subopaque ou luisant; sculpture bien plus faible que chez les ♀ et ☿.

D'un brun noir, pattes, antennes et écaille d'un jaune brunâtre sale.

Hab. In the mountains on all the islands, generally from 2000—4000 ft.

(3) *Ponera gleadowii* Forel, *r. decipiens*, nov. st.

☿. Ressemble énormément à la *P. ragusai* Em. qui me semble aussi être une race de la *gleadowii*. La nouvelle forme a tout à fait la taille et la forme plus grêle et plus allongée de la *ragusai*, mais l'écaille de la *gleadowii i. sp.*, avec la face postérieure aussi haute que la face antérieure. Sa couleur est d'un jaune plus rougeâtre (plus ocreux chez la *gleadowii i. sp.*, brunâtre chez la *ragusai*), sa pubescence plus faible que chez la *ragusai*.

Hab. Kauai on the coast. Hindostan, typical form; Sicily, race *ragusai*.

(4) *Leptogenys falcigera* Roger, var. *insularis* Smith.

☿♂. La *L. insularis* Sm. n'est à mon avis qu'une variété de la *falcigera*.

Hab. Kauai, Oahu, and Maui. Ceylon and Madagascar, typical form.

(5) *Pheidole megacephala* Fab. ☿♂.

Hab. All the islands from the coast to an elevation of 3000 ft. Cosmopolitan.

(6) *Stenamma* (*Ischnomyrmex*) *longiceps* Smith.

Hab. Honolulu (Rothney). Australia.

(7) *Tetramorium guineense* Fab. ♀.

Hab. Oahu, Molokai, Hawaii, and probably the other islands. Cosmopolitan.

(8) *Solenopsis geminata* Fab., *r. rufa* Jerdon.

☿. Cette race est celle de l'Inde qui se distingue de la forme américaine par sa couleur toujours d'un jaune rougeâtre, sa forme un peu plus robuste, avec les ☿ moins extrêmes (surtout la tête des ☿ major moins énorme), enfin par la présence d'une dent plus ou moins distincte au bord antérieur du mésosternum.

HAB. Honolulu, Waianae, etc., abundant. Hindostan and Malaisia. [Typical form North America.]

(9) *Pogonomyrmex occidentalis* Cresson ☿ (de ma collection).

HAB. —?. North America.

(10) *Monomorium floricola* Jerdon ☿ ♀.

HAB. Oahu, Molokai, Lanai, Maui, and probably all the islands. Cosmopolitan.

(11) *Monomorium vastator* Smith ☿.

HAB. Honolulu. Cosmopolitan.

(12) *Monomorium minutum* Mayr, *v. liliuokalanii*, nov. st.

Diffère de la forme typique avant tout par les dents de son épistome beaucoup plus écartées (un peu moins seulement que les arêtes frontales) et plus fortes. Yeux un peu plus en avant (vers le tiers antérieur) de la tête. Pubescence légèrement plus courte et plus appliquée. Premier nœud du pédicule d'une idée plus longuement pétiolé et à nœud plutôt plus bas (plus haut chez la var. *madecassum*).

HAB. Honolulu. Southern Europe, typical form ; varieties in Africa, Madagascar, etc.

(13) *Cardiocondyla wroughtonii* Forel, *v. hawaïensis*, nov. st.

☿. Diffère du type par sa couleur entièrement d'un jaune clair, avec une tache d'un brun roussâtre, nuageuse, de chaque côté de l'abdomen. Les antennes sont un peu plus grêles, les épines un peu plus longues et la sculpture est un peu plus délicate. Les arêtes (bord postérieur) de l'épistome sont aussi latéralement un peu plus aiguës, là où elles rejoignent le bord antérieur.

HAB. Molokai. Hindostan, typical form.

(14) *Cardiocondyla nuda* Mayr, *v. minutior*, nov. var.

L. 1·7 mill. Second nœud du pédicule un peu plus large que long (au moins aussi long que large chez la forme typique). Sculpture plus forte et surtout le thorax plus mat que chez le type. Tête, thorax et pédicule plus ou moins d'un rouge brunâtre assez sombre. Cette variété, plus trapue que la forme typique, ressemble un peu en petit à la v. *mauritanica* Forel, mais elle est plus mate et a les épines plus longues.

HAB. Honolulu and on Molokai. Polynesia, typical form; varieties in Hindostan, Algeria, etc.

(15) *Tapinoma melanocephalum* Fab.

☿. (La forme typique américaine, pas l'*indicum*.)

HAB. Honolulu and Waianae, Oahu; also on Lanai and Molokai, and no doubt the other islands. Cosmopolitan.

(16) *Prenolepis longicornis* Latr.

HAB. Abundant all over the islands on the plains.

(17) *Prenolepis obscura* Mayr.

Blackburn and Cameron, P. Manch. Soc. xxv. (1885—86), p. 174.

HAB. Hawaiian Is. (Blackburn). Not obtained by Mr Perkins, and therefore not verified by M. Forel. Australia.

(18) *Prenolepis bourbonica* Forel, *r. hawaïensis*, nov. r.

☿ ♀ ♂. Plus massive que la forme typique de la Réunion, plus large et moins élancée. Yeux des ☿ un peu plus gros. Poils de la tête un peu plus longs. La pubescence est aussi moins abondante et les nuances de couleur plus différenciées (moins mêlées). La ♀ est plus noire, l'ouvrière plus claire. Chez le ♂, dont les tarses sont jaunes, les valvules génitales extérieures ont une échancrure médiane encore plus forte et la dent plus longue que chez la forme typique. Les ailes sont plus enfumées que chez la r. *bengalensis*, dont les valvules génitales extérieures la distinguent du reste.

La forme du corps de cette forme, sa tête plus large derrière et devant (plus carrée) chez l'ouvrière m'engageraient à en faire une espèce, mais la structure des valvules génitales est trop voisine de celle de l'espèce typique.

Hab. Oahu, Molokai, and Hawaii; from the coast to 4000 ft. Réunion, typical form; a race in Hindostan.

(19) *Prenolepis sharpii*, nov. spec.

♀. L. 4·2 mill. Bien plus petite et plus grêle que la précédente. Tête assez fortement rétrécie devant, à côtés convexes. Ailes plus faiblement enfumées. Ecaille faiblement échancrée. D'un brun noirâtre, avec les mandibules, les scapes, les pattes, l'écaille et le scutellum d'un jaune sale ou légèrement brunâtre. Funicules brunâtres.

♂. L. 2·0 à 2·2 mill. Valvules génitales extérieures larges, très raccourcies, terminées d'un côté par une petite dent suivie de très près d'un feston (Fig. 1). Valvules moyennes pourvues de deux prolongements étroits, longs, faiblement courbés, presque

1 1a

Valvules génitales males.

1, valvule extérieure: 1*a*, valvule moyenne; *i*, prolongement interne; *e*, prolongement externe.

égaux (l'externe un peu plus long) et fortement denticulés à leur moitié périférique et sur les faces qu'ils tournent l'un contre l'autre (les dents sont noires). L'interne est en outre coudé en dedans près de sa base (Fig. 1[a]; *e*, prol. externe, *i*, prol. interne). D'un jaune à peine rougeâtre ou un peu brunâtre sur le mésonotum. Abdomen et dessus de la tête brunâtres.

☿. L. 2·3 mill. Abdomen brun; tête et thorax d'un brun jaunâtre. Pattes et scapes jaunâtres. Poils raides, assez épais, bruns. Tête ovale, assez étroite. Du reste presque impossible à distinguer de la *vividula*, tandis que les valvules génitales du ♂ sont absolument différentes.

Par ses valvules génitales cette espèce se rapproche surtout des espèces de l'Inde, comme *smythiesii* etc.

D'après M. Perkins, cette espèce a été récemment importée de Chine. Elle est en effet plus voisine des formes asiatiques que des formes américaines.

Hab. Honolulu, brought with plants from China.

(20) *Camponotus maculatus* F., r. *mitis* Sm., *v. hawaïensis,* nov. var.

Cette variété (♂, ♀ et ☿ minor) tient du *dulcis* et du *variegatus*. Les tibias sont un peu plus aplatis et plus prismatiques que chez ces deux variétés, les poils du corps un peu plus courts ; la pubescence est bien adjacente. Chez la ♀ le jaune de l'abdomen est disposé en taches plus ou moins distinctes ou confluentes.

Hab. In and around houses in Honolulu. A cosmopolitan species.

Si nous jetons un coup d'œil d'ensemble sur les 20 espèces trouvées jusqu'ici à Hawaï, nous y constatons d'abord l'absence des belles espèces caractéristiques de la Faune des îles Viti et Samoa décrites par Mayr (*Camponotus schmeltzi* etc.).

Quelques espèces absolument cosmopolites et évidemment apportées par les vaisseaux ne donnent aucun point de repère sur l'origine de la faune. Telles sont le *Tetramorium guineense*, la *Pheidole megacephala*, les *Monomorium floricola*, et *vastator*, la *Prenolepis longicornis* et le *Tapinoma melanocephalum*.

D'autres ont une grande étendue, mais caractérisent cependant la faune de l'ancien monde, spécialement la faune indo-malaise. Ainsi le *Solenopsis geminata r. rufa*, le *Leptogenys falcigera* (la var. *insularis* est hawaïenne il est vrai, mais à peine différente du type), le *Camponotus mitis maculatus* r.

D'autres appartiennent à la même faune indo-malaise ou malgache, mais sont représentées aux îles Sandwich par des races ou variétés spéciales. Telles sont les deux *Cardiocondyla*, la *Ponera gleadowii r. decipiens* et la *Prenolepis bourbonica r. hawaïensis*.

Une autre race hawaïenne se rattache à une espèce de l'ancien monde: *Monomorium minutum r. liliuokalanii*.

Autres sont spéciales à Hawaï : *Ponera kalakauae* et *perkinsii ; Prenolepis sharpii*.

Une (*Pogonomyrmex occidentalis*) est de l'Amérique du nord (importée probablement, si l'étiquette est exacte). Une (*Stenamma longiceps*) provient de l'Australie (sans doute importée). La *Prenolepis obscura* me paraît fort douteuse ; peut-être est-ce la *bourbonica* ?

Somme toute, la faune locale paraît se rattacher à la faune indo-malaise surtout (sous-faune océanienne).